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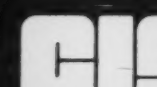

1992 NASA AUTHORIZATION

HEARINGS

BEFORE THE

SUBCOMMITTEE ON SPACE

OF THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY HOUSE OF REPRESENTATIVES

ONE HUNDRED SECOND CONGRESS

FIRST SESSION

FEBRUARY 7, 28; MARCH 5, 6, 12, 13; APRIL 11, 1991

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CONTENTS

WITNESSES

	Page
February 7, 1991:	
Adm. Richard H. Truly, Administrator, National Aeronautics and Space Administration, accompanied by James R. Thompson, Jr., Deputy Administrator, NASA, and Thomas Campbell, Comptroller, NASA	7
February 28, 1991:	
Lennard A. Fisk, Associate Administrator, Office of Space Science and Applications, National Aeronautics and Space Administration, accompanied by Al V. Diaz, Deputy Associate Administrator; and Kathryn S. Schmoll, Assistant Associate Administrator	81
March 5, 1991:	
James T. Rose, Assistant Administrator, Office of Commercial Programs, National Aeronautics and Space Administration, accompanied by Richard H. Ott, Director, Commercial Development Division, and Frank Penaranda, Deputy Assistant Administrator (Programs), Office of Commercial Programs	154
Charles T. Force, Associate Administrator, Office of Space Operations, National Aeronautics and Space Administration, accompanied by Jerry J. Fitts, Deputy Associate Administrator, Office of Space Operations, and Ronald R. Dapice, Director, Administration and Resource Management Divisions, Office of Space Operations	212
March 6, 1991:	
Dr. William B. Lenior, Associate Administrator, Office of Space Flight, National Aeronautics and Space Administration, accompanied by Robert Crippen, Director of Space Shuttle, Office of Space Flight; and Michael Lyons, Director of Flight Systems, Office of Space Flight	246
Stephanie Lee-Miller, Director, Office of Commercial Space Transportation, Department of Transportation, accompanied by Norman Bowles, Associate Director for Licensing Programs, Department of Transportation	307
March 12, 1991:	
Lori Garver, executive director, National Space Society, Washington, DC	333
Dr. H. Frank Eden, chairman, American Geophysical Union Budget Panel	355
Dr. Steven H. Flajser, member, American Institute of Aeronautics and Astronautics Policy Committee, Washington, DC	361
Dr. Patricia Reiff, Space Science Working Group	391
Dr. George C. Sponsler III, chairman, Aerospace R&D Policy Committee, Institute of Electrical and Electronics Engineers, Washington, DC	399
David Gleich, chairman, aerospace division, American Society of Mechanical Engineers, Washington, DC	408
Dr. Arvid G. Larson, vice chairman, public affairs council, American Association of Engineering Societies, Washington, DC	419
March 13, 1991:	
Arnold D. Aldrich, Associate Administrator, Office of Aeronautics, Exploration and Technology, National Aeronautics and Space Administration, NASA, accompanied by Robert Rosen, Deputy Associate Administrator	455

Page

April 11, 1991:
James R. (J.R.) Thompson, Jr., Deputy Administrator, National Aeronautics and Space Administration, accompanied by Dr. William B. Lenoir, Associate Administrator, Office of Space Flight; Dr. Lennard A. Fisk, Associate Administrator, Office of Space Science and Applications; Richard H. Kohrs, Deputy Associate Administrator, Office of Space Flight; and Robert W. Moorehead, Deputy Director, Space Station Freedom Program and Operations 508

APPENDIXES

1. Responses to written questions submitted to Adm. Richard H. Truly by Chairman George E. Brown in accordance with the authorization hearing held on 2/7/91 579
2. Responses to written questions submitted to Adm. Richard H. Truly by Congressmen David Nagle in accordance with the authorization hearing held on 2/7/91 588
3. Responses to written questions submitted to Dr. Lennard A. Fisk by subcommittee Chairman Ralph Hall in accordance with the authorization hearing held on 2/28/91 594
4. Responses to written questions submitted to Dr. Lennard A. Fisk by Congressman Norman Mineta in accordance with the authorization hearing held on 2/28/91 600
5. Responses to written questions submitted to Dr. Lennard A. Fisk by Congressman Robert Torricelli in accordance with the authorization hearing held on 2/28/91 603
6. Responses to written questions submitted by subcommittee Chairman Ralph Hall in accordance with the authorization hearing held on 3/5/91 606
7. Responses to written questions submitted to Charles Force by Congressman Robert Torricelli in accordance with the authorization hearing held on 3/5/91 608
8. Responses to written questions submitted to Dr. William B. Lenoir by Congressman D. French Slaughter in accordance with the authorization hearing held on 3/6/91 609
9. Letter to subcommittee Chairman Ralph Hall from Martin P. Kress, Assistant Administrator for NASA Legislative Affairs, on NASA's activities in the expendable launch vehicle industry 610
10. Testimony regarding the commercial expendable launch vehicle industry submitted for the 3/6/91 record by Howard D. Trudeau of Lockheed Missiles & Space Co 621
11. Responses to written questions submitted to Arnold D. Aldrich by Congressman F. James Sensenbrenner in accordance with the authorization hearing held on 3/13/91 626
12. Subcommittee markup of the NASA Multiyear Authorization Act on 4/10/91 and 4/11/91 629
13. Full committee markup of the NASA Multiyear Authorization Act on 4/24/91 861
14. Letter submitted from the European Space Agency regarding ESA policy on use of foreign launch services 1066

1992 NASA AUTHORIZATION

THURSDAY, FEBRUARY 7, 1991

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, DC.

The committee met, pursuant to notice at 1:05 p.m., in room 2318, Rayburn House Office Building, Hon. George E. Brown, Jr. (chairman of the committee) presiding.

The CHAIRMAN. The Committee on Science, Space, and Technology will come to order. Without objection, permission is granted for coverage of the meeting by television, radio and still photography.

I have a brief opening statement and then I will turn to Mr. Walker for his statement.

Let me say that we made the decision to hold this meeting today in the full committee because of the importance we attach to moving the NASA program forward constructively and expeditiously in this session of Congress. We did not know whether there would be a session of the House today, and that to some degree determines how many members you can get here.

We anticipate having a sufficient number to be able to operate, which is generally two. [Laughter.]

We are pleased that you could be here.

We describe this as a posture hearing that more or less sets the scene for more detailed hearings which will be conducted in the Space Subcommittee under its newly selected chairman, Congressman Ralph Hall of Texas. We know he will do an excellent job.

We also, as you know, have had three earlier hearings on the Augustine report which we think is a good start for taking a new look at NASA programs. We hope that you will be able to give us to some degree your analysis of what that report means and your ability to react to it. We are very hopeful that that report can serve as a basis for achieving a consensus on a stable, growing budget for NASA that will allow us to overcome some of the problems we have had as a result of erratic support in the past.

The budget request this year is a good first step although the increase is modest by past standards. I hope that our work today and in future months with the Administration and with the four committees that deal with NASA can find some common ground on a reasonable long-term budget for the Nation's space program.

This morning in the committee's organizational meeting, we adopted a number of changes that I hope will enhance the committee's ability to deal with major challenges in science and technologies that will affect our nation's future and international competi-

tiveness. The space program has a very important role in our national agenda, and I look forward to the coming months as a time of productive work in directing that role toward greater effectiveness and accomplishment.

I know my good friend Bob Walker shares most of these views that I have expressed, and I would like to turn to him now for any opening statement he might have.

[The prepared opening statement of Mr. Brown follows:]

OPENING STATEMENT

BY

GEORGE E. BROWN JR.

Today the Committee convenes for its posture hearing on the National Aeronautics and Space Administration budget request. This also marks a useful point to begin examining the specific actions and programs that NASA will be proposing in response to the Augustine report.

One of the most pragmatic recommendations of the Augustine report is the suggestion that the Congress and the Administration work to achieve a genuine consensus on a stable budget for NASA that can provide a path of predictable growth for the space program. The budget request this year is a good first step toward this goal, although, the increase is indeed modest by past standards. I hope that our work today, and in future months with the Administration and with the four

Committees that deal with NASA, can find some common ground on a reasonable long term budget for the Nation's space program.

This morning, in the Committee's organization meeting, we adopted a number of changes that I hope will enhance the Committee's ability to deal with major challenges in science and technology that will affect our Nation's future and our international competitiveness. The space program has an important role in our National agenda and I look forward to the coming months as a time of productive work in directing that role toward greater effectiveness and accomplishment.

I would now like to turn to the Ranking Republican, Mr. Walker, for any comments he may have.

Mr. WALKER. Thank you, Mr. Chairman. I do join with you in those remarks, and I think it is significant that the first four hearings that this committee has held this year have been devoted to the future of the space program. I think that speaks to the measure of importance that this issue holds, not only for this committee but for the American people. I think that in the course of this posture hearing and as the issues roll forward this year, we are going to see that importance reflected in the kind of authorizing work that this committee does.

I had a chance to review the NASA budget submitted to us earlier this week by the President, and I am heartened by the emphasis that the Administration continues to place on the importance of a robust space program. I think that what we will hear from NASA is the importance of the priorities that are contained within that budget. I look forward to that testimony and to quizzing the witnesses later on.

Thank you, Mr. Chairman.

The CHAIRMAN. The Chair would entertain any other brief opening statements if members desire to make them.

[The prepared opening statement of Mrs. Morella follows:]

OPENING STATEMENT
CONSTANCE A. MORELLA
SST HEARING
NASA POSTURE HEARING
FEBRUARY 7, 1991

Constance Morella

MR. CHAIRMAN, I WELCOME ADMIRAL TRULY, MR. THOMPSON, AND (OTHER WITNESSES) TO OUR HEARING THIS AFTERNOON.

I AM PLEASED FOR THE OPPORTUNITY TO DISCUSS THE PROPOSED FY92 NASA BUDGET, IN PARTICULAR SOME OF THE ASPECTS OF THE AUGUSTINE COMMITTEE'S RECOMMENDATIONS WHICH WERE ADOPTED IN THE BUDGET AND SOME OF THE RECOMMENDATIONS OF THE AUGUSTINE COMMITTEE WHICH WERE NOT FULLY EMERACED IN THE BUDGET.

AS WE REVIEW THE FY92NASA BUDGET, I BELIEVE WE MUST LOOK AT ALL THE FACTORS NECESSARY TO CREATE A STRATEGIC PLAN FOR THE FUTURE.

THE PRESIDENT'S PROPOSAL FOR THE NASA BUDGET, $15.754 BILLION, WHILE JUST A LITTLE LESS THAN THE BUDGETARY GROWTH RECOMMENDED BY THE AUGUSTINE COMMITTEE, WILL ALLOW NASA TO CONTINUE WITH VITAL PROGRAMS AND ESTABLISH NEW INITIATIVES FOR THE FUTURE.

YET AS WE REVIEW THE FY92 NASA BUDGET, WE MUST LOOK AT ALL THE FACTORS NECESSARY TO CREATE A STRATEGIC PLAN FOR THE FUTURE. I BELIEVE THIS INCLUDES THE NEED TO FOCUS UPON PERSONNEL RECRUITMENT AND PAY REFORM FOR NASA EMPLOYEES IN ORDER TO RECRUIT AND RETAIN THE "BEST AND THE BRIGHTEST."

THE NEED CURRENTLY EXISTS FOR NASA TO MAKE FULL USE OF ALL THE AUTHORITIES AVAILABLE TO IT. NASA SHOULD ALSO PURSUE THE RELIEF MADE AVAILABLE TO THE AGENCY BY THE FEDERAL EMPLOYEES PAY COMPARABILITY ACT OF 1990. AS YOU KNOW, THIS ACT FINALLY RECOGNIZES THE NEED FOR IMPORTANT PERSONNEL RETAINMENT FACTORS SUCH AS LOCALITY PAY, RECRUITMENT BONUSES, AND RELOCATION BONUSES.

THE AUGUSTINE COMMITTEE WAS NOT SANGUINE IN THE FUTURE OF NASA TO "OBTAIN OR RETAIN THE NECESSARY CADRE OF SKILLED PERSONNEL IN A FIELD WHERE THE MOST CRITICAL ASSET IS THE TALENT OF THE INDIVIDUAL PARTICIPANTS." THE REPORT ALSO NOTES THAT NASA IS NOT COMPETITIVE FOR EXPERIENCED SENIOR ENGINEERS AND TECHNICALLY QUALIFIED MID-LEVEL MANAGERS AND SHOULD VIGOROUSLY PURSUE AVENUES NOW ALLOWED BY NEW LEGISLATION TO FILL THESE MORE SENIOR POSITIONS.

I LOOK FORWARD TO DISCUSSING THESE ISSUES WITH YOU TODAY.

Mr. VOLKMER. Mr. Chairman, I would just like to say that I look forward to hearing testimony from Admiral Truly. I am sorry I am not going to be able to stay through the whole hearing probably. I have another obligation over in the Agriculture Committee, but I look forward to working with Admiral Truly and everybody in NASA to continue the successes that we have had in the past. Even though we learn from mistakes, I am sure that we are not going to make all those same mistakes again.

Thank you very much.

The CHAIRMAN. Thank you, Mr. Volkmer.

Mr. FAWELL. Mr. Chairman, I must also say that I have a labor/civil rights issue that I have to attend very shortly, but I am interested in the NASA budget and the implementation of the Augustine report.

I am not on the subcommittee, but it is an area of interest and I expect to certainly review all of the materials which I have just recently picked up. I look forward to what portion of the testimony I can be privy to.

The CHAIRMAN. We thank the gentleman very much for his comments and we certainly understand the situation.

We welcome you, Admiral, with your colleagues. You are the entire program for this afternoon, and we are going to grant you such reasonable amount of time as you may wish. You do not have to take the whole afternoon, of course. You may proceed.

STATEMENT OF ADM. RICHARD H. TRULY, ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, ACCOMPANIED BY JAMES R. THOMPSON, JR., DEPUTY ADMINISTRATOR, NASA, AND THOMAS CAMPBELL, COMPTROLLER, NASA

Admiral TRULY. Mr. Chairman, thank you very much. I can tell you that I am delighted to be here to present to you an overview of the President's 1992 request to the Congress for NASA. With me to my left is Mr. J.R. Thompson, the Deputy Administrator of NASA, and to my right is Mr. Tom Campbell, the NASA Comptroller who will assist me in answering any of your questions.

I come here on a day when our troops are in combat in Iraq and, here at home, we struggle with economic problems across our nation, but frankly, I think that it is in times like these that we most need to plan for the future. It is also in times like these that we see the value of investments in technologies, in science and research, as they pay off. These investments for the future are exactly what NASA and the civil space program and our aeronautics research are all about.

The 1992 budget that the President has submitted to the Congress is a strong request in a series of strong requests that he has made. It manifests the President's belief that NASA can and does make significant contributions to our ability in our nation to compete in the global marketplace, contributions to our national pride, to our accomplishment, to our intellectual spirit, to the understanding of this fragile earth that we live on, and to our economic and national security.

This budget request is a prudent request. It balances priorities within NASA and within the Administration's overall budget sub-

mission. There have been some tough choices to put this balanced budget together. I believe it is a sober assessment of what the agency needs to implement the civil space program, and about 99 percent of this budget is applied to programs that have already been approved and are under way with the authorization and appropriation from the Congress. I believe it is a realistic assessment of what it takes to maintain U.S. leadership in space and to develop those critical new technologies for a secure future.

It manifests the strong support of the President for both the civil space program and the aeronautics program. It reflects Congressional guidance to temper the proposed rate of growth of NASA programs and also to restructure Space Station Freedom, which I will summarize later in my remarks, and I believe that it responds very positively to the "Report of the Advisory Committee on the Future of the U.S. Space Program." I commend the committee, so early in the year, in taking the time to have hearings and learn, not only from the committee but from others and how they view its work.

Coming off 1990, as I look back on the past year, as you know, we had our share of challenges. We got into the newspaper with the problems, principally, with the Hubble Space Telescope and also with some hydrogen leaks in the Space Shuttle. But let me say, in looking back on last year, that we did not hurt the hair on one person's head as we walked our way through these problems; that we came through the year safely and successfully.

We launched six safe and successful Space Shuttle missions, Galileo, Hubble, the Ulysses spacecraft for the European Space Agency; two vital and precious DOD national security missions and an Astro 1 science mission were flown, which not only looked at the universe to gain more knowledge about it, but provided a unique educational forum from space for our school children. We are today, as I testify, mapping the surface of the planet Venus with Magellan, and we brought back unprecedented images of the Milky Way and the solar system thanks to the Cosmic Background Explorer and to Voyager, all done in 1990.

As effective as NASA has been over the years, frankly, it has been my view in the year and a half that I have been administrator that we need to improve further. Therefore, I requested an assessment of the space program and of NASA to be undertaken by an independent panel of experts.

The results of this critical but constructive assessment are contained in the "Report of the Advisory Committee on the Future of the U.S. Space Program," which was chaired by Norm Augustine. This report was thorough. It left no stone unturned. It is critical in certain areas, but I asked the committee to be critical, and their criticisms, frankly, I believe, are constructive. We have already moved out to begin to implement them.

Let me point out to this committee and to the Congress that the consensus required and the funding and people that it takes to implement this view of the Nation's requirements of the space program cannot be done by NASA alone. We require the full support of the President and the Administration and we also require the support of our oversight committees and stable and adequate funding to do the job.

Therefore, this 1992 budget is more than dollars. It is a budget combined with this report and a look at the future. I intend to try to make NASA what I would call a more excellent agency. The request represents the desire of the President to forge a consensus on goals and objectives of the space program so that we can quiet the system down, take the resources that are available, and go do the work.

I would like to very briefly discuss the three thrusts of the NASA mission and then what it takes to do them. Those three thrusts are science, technology, and exploration. What it takes to do them is enabling investments in capabilities and people and facilities and in dollars.

In our space science program which was endorsed very favorably in the Augustine report, we are well under way to a significant new period of achievement. Over the next five years, no less than 35 major space science missions are scheduled to be launched.

Before the end of the decade, we will have visited Venus, Jupiter, Mars, Saturn, and the Comet Tempel 2, and we will have deployed three great observatories: Hubble, the Gamma Ray Observatory—here in just a few months—and the Advanced X-Ray Astrophysics Facility. The science budget also provides and supports a full complement of other smaller missions and payloads that serve communications, micro-gravity research, international missions such as the Shuttle SpaceLab J, a cooperative venture with Japan, and the Life Sciences SpaceLab program.

This budget represents a firm commitment to a solid foundation of ongoing programs and the maintenance of U.S. leadership in space science. There is a new initiative in the space science budget this year which is called LifeSat, a recoverable life sciences satellite to help define radiation protection requirements that are necessary for the long term habitation and exploration of space.

The budget maintains a sustained commitment on the part of the Administration and NASA in understanding the planet Earth. There is a new update put out by the Administration on the U.S. Global Change Research Program for 1992 that has been provided to the Congress.

We are looking within NASA at ways to restructure the Mission to Planet Earth to be a continually evolving program and to investigate the use of different sized spacecraft in the program. This study will be underway this spring and we look forward, when it is completed, to communicating it with this committee.

Also in the Global Change program in addition to the Earth Observation System is a series of Earth Probes which, together with the Earth Observation System make a strong attack on understanding the knowledge and the makeup of our earth. The Earth Probes, principally in near-term missions, will take a look at global ozone, ocean surfaces, and tropical rainfall measurements.

The second major thrust of the request before you and of the NASA mission is technology: technology both to do our missions and efforts to transfer that technology into private companies across our land to assure our economic wellbeing and competitiveness. Frankly, in recent years, the space technology budget has fared poorly. We have simply been unable to make those research investments over the last few years.

The Augustine committee recommended that our base technology budget be increased by a factor of two or three times. The fiscal year 1992 budget takes a major step in that direction by enhancing programs in that area. We intend, during 1991, to do a better job within NASA by putting together an agency-wide space technology plan including a peer review by outside experts similar to the strategic plan in our science programs.

The NASA aeronautics program continues to be supported strongly. As you know, it is absolutely critical to the wellbeing of the U.S. in terms of trade, of transportation, and of national security.

The emphasis in 1992 in this budget is aid to more efficient aircraft and propulsion systems design, to advance composite materials and structures, and to aircraft safety. The high speed research program will continue to address environmental issues, particularly associated with the High Speed Civil Transport potential development by U.S. industry.

There is a major initiative within the aeronautics budget which is the High Performance Computing and Communications Program which is an interagency program. There is also a report to the Congress as to NASA's role and to the role of other agencies in this area. The goal of the High Performance Computing program is to improve computing capability by the United States by about 1,000 times by 1996. NASA plays a key role in this initiative.

This committee is also concerned and has given great support to the development and research on the National Aero-Space Plane. I am pleased to report that in the past year, joint technology activities in this joint program by the DOD and by NASA have made significant strides. The 1992 budget request will support a 1993 decision as to the potential development of two experimental flight vehicles.

The third major thrust of our mission is exploration. Mankind has always had a fundamental need to explore and to expand his horizons. President Bush remains firmly committed to the space exploration initiative and his long-term goal, announced in 1989, of long-term manned and unmanned exploration of the solar system. This was further endorsed by the Augustine committee as the prudent and logical long-term goal of the civil space program.

This coming spring, Lieutenant General Thomas Stafford and his so-called Synthesis committee will report to me on their work and then to the Space Council and to the Congress as to their recommendations on enabling technologies and candidate architectures required to enable the exploration of the solar system.

The 1992 budget in exploration is based on a strategy of focusing on conceptual mission studies and on selected key long-lead technologies that will be necessary for any future exploration endeavors, such as space surface nuclear power, space nuclear and advanced cryogenic propulsion, and especially life sciences and life support technologies.

Underpinning these three major thrusts are the required enabling investments that it takes for us to do our job. First of all and most important, is Space Shuttle, and included in the Space Shuttle request this year is an initiative called the Assured Shuttle Availability Program.

The shuttle remains absolutely vital to our space objectives and continues to demonstrate its unique capabilities to launch, to retrieve payloads, and to perform space research. We are absolutely committed to safe and reliable flight operations, and the new Assured Shuttle Availability Program, frankly, is a new management technique that we discussed briefly with the Congress last year. It is a formal funding mechanism for high priority improvements required by the shuttle system.

The manifest that is supported by the 1992 shuttle budget supports nine flights in fiscal year 1992, nine in 1993, ten in each of fiscal years 1994, 1995, and 1996. It is a very supportable transportation plan.

The Advanced Solid Rocket Motor is supported to provide the Space Shuttle safety margins and reliability and will provide a significant increase in capability. We have baselined the ASRM to support the assembly and construction of Space Station Freedom when it is available. Pursuant to your guidance, we are initiating studies on ASRM cost, performance, schedule, and safety enhancements.

Also supported in the budget is the continued production of orbiter hardware and the procurement of the structural spares in order to reduce the time to repair a damaged orbiter and to maintain orbiter production capability. The extended duration orbiter is well into development. It will allow us to fly up to 16 days. We are flying today a number of eight day, nine day, and ten day missions with our current orbiters, and we plan the first thirteen day mission for the United States Micro-Gravity Lab 1 in 1992. The new orbiter, the Endeavor, is on schedule and under cost and will be rolled out this coming spring.

Supplementing the shuttle, of course, is our mixed fleet, expendable launch vehicles. We continue to commit to the commercial launch industry to use their wares and to develop into a competitive factor in our economy.

This budget will transfer the TDRS 7 spacecraft from the Space Shuttle to an ELV, and we have continued to request funds and still do for several missions for a variety of small, medium, and intermediate ELVs provided by the commercial space launch industry and large ELVs in the case of the Titan 4 from the DOD.

Another major new initiative in this budget is the proposal for a new launch system to be developed jointly by NASA and the Department of Defense. This nation simply must have a more robust space transportation system in future decades.

This new launch system will be designed to provide for a range of payloads up to and including a heavy lift capability. Options for configuration, for cost, for capability and for scheduling are presently being looked at under the leadership of a joint NASA/DOD team. We plan to go back to the National Space Council next month with the results of that first look, and I am anxious to share the findings of that study with the committee when it is completed.

This new endeavor will be jointly funded and managed by DOD and NASA. We intend to take an evolutionary approach to the introduction of new technologies and we are searching for significant improvements in operating costs and operational resilience.

Another enabling investment we need is the continued investment in our ground communications and tracking networks. We have a large network, worldwide, of ground stations and an in-space constellation presently serving national requirements in our Tracking and Data Relay Satellites.

Underpinning all of this and most important are our people and the facilities that it takes to do the job. We cannot be leaders in space or space exploration without a first class institutional capability.

The Augustine committee said, "NASA and only NASA realistically possesses the essential critical mass of knowledge and expertise upon which the Nation's civil space program can be sustained." We require your support for the resources for these people to do their jobs and for the facilities that they work in.

I am in discussions today with the Office of Personnel Management to explore every opportunity that I can find to have a more flexible personnel management. I have announced the new position of Associate Administrator for Human Resources to ensure that we are able to recruit and retain the very best.

In addition to people, we also need first class, world class facilities. We have them today but we need to continue to invest, both in their construction and also in their maintenance and upkeep. They range from research laboratories to world class wind tunnels, launch pads, rocket test stands, and tracking stations. We require these resources to protect the Nation's investment and they are high priorities in the fiscal year 1992 budget.

Commercial space is supported very strongly in this budget, and we are proud of what we have accomplished in this sector in the last year. A key ingredient to this has been the NASA Centers for the Commercial Development of Space Program. Sixteen CCDSs supported by NASA combine the talents of the Nation's university, industrial, and research communities to help create new markets for space products and services.

We also are committed to the dissemination of technical information and technology from our programs to the Nation's business, research, and industrial communities to enhance their competitive posture. This program is run principally through our commercial organization.

I would like to give you a brief status on Space Station Freedom and the restructuring exercise that we presently have underway. Space Station Freedom continues to be the cornerstone of our future space program with the principal missions of life sciences and of micro-gravity research.

We are presently in the midst of a restructuring exercise. I have requested a 30 day extension to report back to the Congress which will be up in early March, and I hope to make that date. If I cannot, I intend to ask for the short amount of time to do it because I want to come back and make it clear to you that we have been responsible to the Congress in doing this.

I believe that what you will find when we come back—I am sure of it—is that Space Station Freedom will honor our international commitments; it will be within the strict budgetary guidelines you have named, and it will be consistent with our national space policy. In other words, it will be smaller; it will retain its quality; it

will require less shuttle flights; it will be easier to build; it will require EVA and maintenance to maintain it; it will be less expensive. We have done the exercise in concert with our international partners and it will meet our international commitments.

We have worked tirelessly within the agency over the last few months to formulate a good program. What I believe we need in 1992 is a consensus that this is the program that we need to stop arguing about and need to allow the engineers to go build. When the review is complete, I will transmit the report to you and I believe that you will find it responsive.

I would like not to leave this opportunity without mentioning a special emphasis that NASA has and a special concern that I have which has to do with education, particularly math and science education. I believe that we have a special capability to stimulate young people's interest in science, mathematics, and engineering with our programs of planetary research, astronauts, airplanes—simply, we can get the kids.

Our programs are designed to get the young people at an early age, to channel them into careers in math and science, and to put tools into the hands of teachers in order to help them. We have readily adopted the goals of the President and the governors for our educational system, and we are part of a major effort pulled together by Dr. Alan Bromley as head of OSTP as an interconnecting government program to work with other agencies on education.

There is a comprehensive report from the FCCSET committee which I would recommend to each of you. In here, there is an excellent but short section on the NASA education program and how we believe that we can contribute directly to our young people.

In summary, Mr. Chairman, I believe that the 1992 budget presented to you by the President for NASA shows his strong support. I believe it is a prudent and responsible budget.

It does have major new and important initiatives, but principally it supports the programs that the Congress has already authorized and appropriated, and it does make tough choices. Frankly, I think the rewards of such a program as NASA are simply enormous. We develop new materials, new medicines, new products, new processes; we create jobs and the best kind of jobs because they in turn create others to bring our economy forward.

I believe that this year we need to make a special effort with this committee and with the others to form a consensus on the space program; to make a commitment to make sure that this chapter in American history will be written by our generation. I believe that the 1992 budget is the next in a series that does form a blueprint. It is supported, I think, by the thrust of the Augustine committee, and I am pleased to bring it to you for your consideration and to attempt to answer any questions that you or any member of the committee might have.

Thank you, sir.

[The prepared statement of Admiral Truly follows:]

Statement of

Richard H. Truly
Administrator

National Aeronautics and Space Administration

before the

Committee on Science, Space and Technology

House of Representatives

Mr. Chairman, Members of the Committee:

I am pleased to appear before the Committee and to have the privilege of presenting the President's FY 1992 budget request for the National Aeronautics and Space Administration.

These are challenging times for America. Our troops, in alliance with other nations, are engaged in combat with Iraq in support of the basic right of nations and people to be safe from aggression. It's at times like these, when we deal with the pressing realities of today, that we most need to plan for the opportunities of tomorrow; and at times like these when the benefits of our nation's prior investments in research and technology are most apparent.

As we consider America's future, it is appropriate today to remember the words of Dwight D. Eisenhower to NASA's men and women in 1960 at the dedication of the Marshall Space Flight Center: "All that we have already accomplished, and all in the future that we shall achieve ... is the product of unrestrained human talent and energy restlessly probing for the betterment of humanity ... We are propelled in these efforts by ingenuity and industry -- by courage to overcome disappointment and failure -- by free-ranging imagination -- by insistence upon excellence ... hard work, toughness of spirit, and self-reliant enterprise are not mere catchwords of an era dead and gone. They remain the imperatives of the fulfillment of America's dream."

FY 1992 Budget

Today, those imperatives and that dream continue and are reflected in the President's budget request of $15.7 billion for NASA. This request manifests the President's belief that NASA activities make significant contributions to our competitive posture in the global marketplace, to our national pride and accomplishment, to our creative and intellectual spirit, to our understanding of the fragile Earth we inhabit, and to our economic and national security. An investment in NASA is an investment in America's future. I believe the American public also shares these views and supports our civil space and aeronautics program.

The FY 1992 budget request represents a prudent budget and a balancing of priorities in the Administration's overall budget submission. It's a sober assessment of the resources required to implement the civil space program approved by the Congress in FY 1991; it's a realistic assessment of the resources required to maintain U.S. leadership in space and to develop the critical technologies required for a secure economic and national future.

The President's budget request:

- manifests the strong support of the President for the civil space and aeronautics program;
- reflects Congressional guidance to temper the proposed rate of growth of the NASA budget and to restructure the Space Station Freedom; and
- responds to the recommendations of the Report of the Advisory Committee on the Future of the U.S. Space Program.

It is a budget worthy of your support and a budget well within available domestic discretionary resources in FY 1992.

NASA in 1990

As you are all well aware, NASA had it's share of challenges in 1990. The Space Station EVA Report, the Hubble Space Telescope spherical aberration, and hydrogen leaks on the Space Shuttle all posed difficult engineering challenges and required serious technical reviews, top management attention and positive actions.

But 1990 also was a year of successes and accomplishments. In 1990, we launched six safe and successful Space Shuttles, we successfully guided the Galileo spacecraft past Earth on its way to Jupiter, we deployed the Hubble Space Telescope, the Ulysses spacecraft for the European Space Agency, two DOD spacecraft, and the Astro mission that, in addition to providing significant scientific information on black holes, quasars and other scientific phenomena, provided a unique educational forum for schoolchildren. We made progress mapping the surface of Venus as a result of the Magellan mission, and we produced unprecedented images of the Milky Way, thanks to Cosmic Background Explorer, and of our solar system, thanks to Voyager.

Report of the Advisory Committee on the Future of the U.S. Space Program

As effective as NASA has been over the years, it was clear to me that NASA needed to improve further to fulfill our future missions and promise. Therefore, I requested that an assessment of NASA and its future agenda be undertaken by an independent panel of experts. The results of this constructive assessment of NASA are contained in the Report of the Advisory Committee on the Future of the U.S. Space Program that was chaired by Norman R. Augustine.

This report was thorough, left no stone unturned, and made recommendations that will help NASA to better implement our objectives and better manage the taxpayers' money.

Change is never easy. But it is clear to me that NASA must change if we are to successfully accomplish our programs and maintain and broaden our base of support. However, to implement this report will require more than the support of the NASA management, it also will require the support of the Administration, the Congress, as well as stable and adequate funding.

FY 92 Budget - More than Dollars

NASA's FY 1992 budget request is more than a request for dollars for programs and projects. It is a request for the assistance of this Committee to help make NASA a "more excellent" agency.

The FY 1992 budget request also represents the desire of the President to forge a consensus on the goals and objectives of the civil space program and to commit to provide the necessary financial resources, personnel, and facilities to implement the civil space program.

NASA's Mission -- Science, Technology, Exploration

What are NASA missions? Why should you support this budget request?

NASA's mission embodies three major areas of endeavor: **science**, **technology**, and **exploration**. Each of these missions is important to the overall goals and objectives of the Agency but, more importantly, each of these missions is important to national objectives that have been identified by the President and the Congress.

Today, I would like to briefly describe the key elements of each of these mission areas and to give you a better idea of what the NASA of the 1990's is all about. After I do that, I will briefly discuss the **enabling investments** contained in the budget request. These investments in hardware, research, spacecraft, launch systems, facilities, and people will turn our missions into realities. Finally, I will give you an interim report on the restructuring of the **Space Station Freedom** and tell you about the special emphasis NASA is putting on **education**.

Science

In the 1990's, the NASA space science program represents a commitment to expansion of our knowledge of the universe we live in and the planet we inhabit. In FY 1992, we will continue to implement the Office of Space Science and Applications Strategic Plan, as recommended by the Augustine Committee and other NASA advisory bodies.

Planned Missions

Over the next five years, 35 major space science missions are scheduled to be launched and more missions are in the pipeline. Before the end of the decade, we will have visited Venus, Jupiter, Mars, Saturn, and the Comet Tempel 2, and we will have deployed three great observatories -- the Hubble Space Telescope, the Gamma Ray Observatory scheduled for launch this April, and the Advanced X-Ray Astrophysics Facility. We also will have serviced these great observatories starting with the Hubble Space Telescope in 1993.

The 1992 budget request also supports a full complement of space science and applications payloads, including the Upper Atmospheric Research Satellite, ATLAS, the Advanced Communications Satellite System, the United States Microgravity Laboratory, the International Microgravity Laboratory, Space Life Sciences Laboratory, and Spacelab J. The FY 1992 budget represents a firm commitment to a solid foundation of ongoing programs and to the maintenance of U.S. leadership in space.

New Initiative -- Lifesat

The proposed budget also includes funding for a new initiative to develop a recoverable life sciences satellite called Lifesat. This satellite will help define radiation protection requirements for the long-term habitation and exploration of space.

Mission to Planet Earth

FY 1992 also manifests NASA's sustained commitment to understanding the planet Earth. The Mission to Planet Earth (MTPE), NASA's contribution to the U.S. Global Change Research Program, is strongly endorsed in the budget submission and manifests the commitment of the Agency and the Administration to this program with important ecological benefits.

NASA is exploring ways to restructure MTPE as a continually evolving program and to investigate the use of different size spacecraft. The development of this revised program plan should be under way this spring, and initial results will be provided to the Committee as soon as possible.

The Earth Probes program also has a strong endorsement in this year's budget. These highly-focused Earth science investigations require unique orbits and sensors, and will give us the capability to collect data in the near-term on global ozone, ocean surfaces, and tropical rainfall. Five Earth Probe missions are currently planned and procurement activities are underway for the acquisition of data by the Ocean Color Mission.

Technology

Investment in technology is critical to maintaining U.S. competitiveness, enhancing our economic well being and assuring U.S. world leadership in space.

Space Technology

Unfortunately, the space technology budget has fared poorly in recent years and NASA has been unable to make the investments in technologies that will be required to support many future space science, Space Station, and space transportation activities, or to invest adequately in technologies that will enable expanded human and robotic exploration of the solar system. The FY 1992 budget request enhances funding of this program area, and NASA has initiated a process to develop an Agencywide space technology plan by late 1991, to include review by an outside panel of experts.

Aeronautics

Meanwhile, NASA continues to move out aggressively with an aeronautics technology program critical to the well being of the U.S. in terms of trade, transportation, and national security. In the 1992 budget submission, emphasis continues to be placed on numerical simulation techniques to aid in more efficient aircraft and propulsion systems design, advanced composite materials and structures, and aircraft safety. In FY 1992, the High-Speed Research Program will continue to address the critical environmental issues associated with high-speed civil transport development by U.S. industry, and will initiate a critical enabling engine materials program.

High Performance Computing and Communications Program (HPCCP)

A new governmentwide HPCCP is also included in the budget request. The goal of the HPCCP is to improve computing capability by about 1,000 times over current systems by 1996. NASA plays a key role in this initiative and is responsible for bringing together interdisciplinary teams to accelerate the development and application of high performance computing technology to meet its science and engineering requirements.

National Aero-Space Plane

Joint technology activities between NASA and the Department of Defense on the National Aero-Space Plane (NASP) program continue to make great strides, and the FY 1992 budget request will support a 1993 decision on the development of two experimental flight vehicles. Investments in NASP and enabling technologies are vital to future generations of military and civil aircraft and to U.S. dominance of these critical markets.

Exploration

Mankind has always had a fundamental need to explore and to expand his horizons, and the President remains firmly committed to the Space Exploration Initiative and his long-term goal announced in 1989 of manned and unmanned exploration of the solar system.

This spring, Lt. General Thomas Stafford and his Synthesis Group will report on their work, and NASA and the Congress will receive their recommendation on enabling technologies and candidate architectures required to enable the exploration of the Moon and Mars.

For 1992, the budget is based on a strategy of supporting activities focused on conceptual mission studies and on selected, key long-lead technologies that will be necessary for any future exploration endeavors. These technologies are: space surface nuclear power, space nuclear and advanced cryogenic propulsion, and life sciences and life support technologies.

Meanwhile, I have initiated a search for a new Associate Administrator for Exploration and plan to have this new Associate Administrator on board in June.

Enabling Investments

The unique capabilities of NASA's Space Shuttle, Space Station Freedom, Expendable Launch Vehicles, the Advanced Solid Rocket Motor, the Tracking and Data Relay Satellite System, facilities and workforce constitute a critical base upon which we can achieve our missions. In the FY 1992 budget request, an additional element of this space infrastructure will be initiated as a joint program with the DOD -- a New Launch System.

Space Shuttle and Assured Shuttle Availability Program

The Space Shuttle remains vital to our space objectives, and continues to demonstrate its unique capabilities to launch and retrieve payloads and to perform space research. The FY 1992 budget request represents a continued commitment to safe and reliable flight operations, including a new Assured Shuttle Availability Program that establishes a formal funding mechanism and process for high priority improvements in the Space Shuttle. The FY 1992 budget request supports 9 flights in FY 1992, 9 flights in FY 1993, and 10 flights each in FY 1994 through FY 1996, which is a very supportable transportation plan for the upcoming years.

Advanced Solid Rocket Motor (ASRM)

The FY 1992 budget request supports the ASRM program that will enhance Space Shuttle safety margins and reliability. We expect a significant increase in the performance capability of the ASRM-equipped Shuttle and have baselined the ASRM for the Space Shuttle

flights to deploy Space Station Freedom when the ASRM is available.

Pursuant to Congressional guidance, NASA has initiated a group of studies relative to ASRM cost, performance, schedule, and safety enhancements. NASA has submitted a "finding" to the Congress concerning its technical review of the ASRM nozzle and its decision to use an ablative material instead of a carbon/carbon material for the throat entrance in order to minimize technical risks and costs.

Production of Orbiter Hardware

Production of orbiter hardware in support of the current fleet's operational requirements will continue. This budget request also continues the procurement of structural spares to significantly reduce the time to repair a damaged orbiter and to maintain orbiter production capability. Work is continuing on the hardware necessary to provide an extended duration orbiter capability to allow an orbiter to remain on orbit up to 16 days, beginning with a planned 13-day mission for USML-1 in 1992.

Expendable Launch Vehicles (ELV's)

In addition to the Space Shuttle, launch services continues to be procured from the private sector, where available, as part of NASA's continued commitment to a healthy and expansive commercial space industry and to a mixed fleet. The FY 1992 budget request accommodates the launch of the Tracking and Data Relay Satellite (TDRS) 7 on an ELV and NASA has requested funds for several missions for a variety of small, medium, intermediate and large ELV's.

New Launch System

The current mixed fleet of ELV's and Space Shuttles provides a base for our current requirements of transporting people and payloads to low Earth orbit. The Space Shuttle is the most versatile and advanced launch system in the world. However, the nation simply must have a more robust space transportation system in future decades. Therefore, the Agency has included funding in the FY 1992 budget request to continue technology development for a New Launch System for a range of payloads up to and including a "heavy-lift" capability. Options for configuration, cost, capability, and schedule for such a launch system are currently being assessed by a joint NASA/DOD team scheduled to report back to the Vice President and the National Space Council in March. As soon as that analysis is completed, and assessed by the National Space Council, the Agency is anxious to share its findings with the Committee.

This new launch system will be jointly funded and managed by DOD and NASA and will provide a range of cargo capabilities, incorporate an evolutionary approach to introduce new technologies, and achieve significant improvements in operations costs and operational resilience.

Ground and Space Communications

The NASA ground and space communications networks provide vital capabilities to meet the requirements of all NASA flight projects. This is accomplished through the use of a network of NASA ground stations and by three Tracking and Data Relay Satellite (TDRS) spacecraft working with a highly specialized ground station. This budget request funds the equipping of a second TDRS ground terminal, TDRS spacecraft (TDRS 6 & 7), and development of an advanced TDRS to extend network service into the 21st century. TDRS 8 funds have been deleted from the FY 1992 budget request. As noted above, TDRS 7 will be launched on a competitively procured commercial ELV.

People and Facilities

NASA's unique technical expertise and facilities are the underpinning for the successful accomplishment of the nation's aeronautics and space programs. We cannot be leaders in space exploration without a first-class institutional capability.

The FY 1992 budget request represents a commitment to a NASA with the superior managerial and technical capability needed to monitor and direct civil space and aeronautics efforts. As the Augustine Committee appropriately noted, "NASA, and only NASA, realistically possesses the essential critical mass of knowledge and expertise upon which the nation's civil space program can be sustained." These world-class scientists, engineers, technicians, and support staff require your support and the resources required to do their jobs. Funding for additional civil servants is requested in FY 1992 primarily to meet the increased workload associated with the Earth Observing System. Additional contractor conversions are planned in FY 1992 to ensure critical in-house capabilities -- these conversions are budget neutral.

NASA has also initiated discussions with the Office of Personnel Management to explore opportunities to designate NASA as a pathfinding agency for flexible personnel management. I have also announced the new position of Associate Administrator for Human Resources to ensure that NASA will be able to recruit and retain the best technical and managerial talent -- the type of people required to carry out an ambitious civil space program.

In addition to first-class people, first-class facilities also are required to maintaining our nation's leadership position. NASA's research laboratories, computing capabilities, aeronautical facilities, Space Shuttle launch facilities, rocket test stands, and deep space tracking stations are unique resources and key to maintaining our nation's leadership position. The maintenance, repair, rehabilitation, and modernization of NASA's facilities are required to protect the nation's investment and are high priorities in the FY 1992 budget request.

Commercial Space

In addition to NASA's direct investment in enabling technologies, space infrastructure, people, and facilities, the FY 1992 budget request continues NASA's commitment to work with the private sector to develop space hardware and transportation systems. A key ingredient to this initiative is the NASA Centers for the Commercial Development of Space (CCDS) program. Sixteen CCDS's, supported by NASA, combine the talent of the nation's university, industrial, and research communities to help create new markets for space products and services.

This request also manifests NASA's strong support and commitment to the utilization of commercially provided hardware and services, such as the Commercial Middeck Augmentation Module and the Commercial Experiment Transporter, and to the dissemination of technical information to the nation's business, research and industrial communities to enhance their competitive posture.

Space Station Freedom

The cornerstone of the space program of the 1990's and the 21st century is the Space Station Freedom -- the largest joint international endeavor in science and technology ever undertaken. At present, NASA, in consultation with its international partners (ESA, Japan and Canada), is finalizing a restructured Space Station Freedom program which meets Congressional programmatic and budgetary guidelines, incorporates the recommendations of the Augustine Committee, honors our international commitments, and is consistent with national space policy. When this final plan is completed in the coming weeks, I am confident you will concur that the final proposal is affordable; simplifies assembly and operation; and reduces the size, complexity, number of Space Shuttle launches and extravehicular activity requirements, still meeting its priority user requirements -- life sciences and microgravity research -- and maintaining overall safety. We need to formulate a consensus on Space Station Freedom. The NASA team has worked tirelessly in this restructuring exercise to meet the guidelines, and I hope you will work with us now to turn this program into a reality.

When this review is complete, I plan to package the final recommendations and to transmit the report to the Congress according to the guidelines in P.L. 101-507. I then hope to have an opportunity to review this proposal with you.

Education: A Special Emphasis

The FY 1992 NASA budget requests a 17 percent increase for Academic Programs and represents a sustained commitment on the part of NASA and the President to stimulate young people's interest in science, mathematics, and engineering; to provide resources and training to enable teachers to incorporate aerospace concepts into their classroom lesson plans; and to support our nation's

universities and graduate students in mathematics, science, and engineering. NASA has readily adopted the national educational goals set by President Bush and the nation's Governors and has formulated a Memorandum of Understanding with the Department of Energy to collaborate on education programs to help improve the nation's science, engineering, and math programs. NASA is part of a multiagency Education and Human Resources initiative coordinated under the auspices of OSTP's Federal Coordinating Council on Science, Engineering and Technology (FCCSET).

The FY 1992 budget request continues important ongoing programs such as the Spacemobiles, LASER and Space Grant Colleges and Fellowship Program, plus new educational initiatives geared to minorities and women. Experimental programs are aimed at regions of the nation that have not previously benefited from research activities in space science and engineering.

NASA's investment in educational activities is a critical element of a comprehensive civil space program and a sound investment in the scientists, engineers and astronauts of tomorrow.

Summary

"Some say the space program should wait -- that we should only go forward once the social problems of today are completely solved. But history proves that attitude is self-defeating. Many an American schoolkid has read the story of Columbus' doubters, and shook their heads in disbelief that these naysayers could have been so shortsighted. We must not let the schoolchildren of the future shake their heads at our behavior."

Mr. Chairman, I believe these remarks last year by President Bush to the men and women of NASA are appropriate for all of us today. We are standing at the edge of a new frontier and the rewards are enormous -- from better understanding of our universe and our planet, to new materials, medicines and medical understanding, from new technologies to new products and processes that will capture future markets. But unless we are able to forge the necessary consensus and make the necessary commitment this year, this chapter of the American dream will be written by future generations -- not by ours. The FY 1992 NASA budget request represents the blueprint for the civil space program for which we seek your commitment.

Mr. Chairman, let's put the consensus in place this year, let's agree to provide the resources, and let's start this incredible voyage into what the President has called "the next American century." History proves that we have never lost by pressing the limits of our frontiers. Together, let's write another chapter of American history.

NASA
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Biographical Data

RICHARD H. TRULY
NASA Administrator

Richard H Truly became the eighth administrator of NASA on July 1, 1989. One day earlier, he concluded his naval career of more than 30 years, retiring as a Vice Admiral. He is the first astronaut to head the nation's civilian space agency.

Truly became NASA's associate administrator for space flight on Feb. 20, 1986. In this position, he led the rebuilding of the Space Shuttle program. This was achieved by NASA on Sept. 29, 1988, when Discovery lifted off from Kennedy Space Center, Fla., on the first Shuttle mission in almost 3 years.

Before returning to NASA, the former Shuttle astronaut served as the first commander of the Naval Space Command, Dahlgren, Va., established Oct. 1, 1983. His career in the U.S. Navy began in 1959, when he was commissioned an ensign. This coincided with his graduation from the Georgia Institute of Technology, which he attended as a Naval R.O.T.C. midshipman and earned a bachelor's degree in aeronautical engineering.

Following flight school, he was designated a naval aviator in 1960. His initial tour of duty, Fighter Squadron 33, was aboard the USS Intrepid and USS Enterprise, and he made more than 300 carrier landings. From 1963 to 1965, he was a student and then an instructor at the U.S. Air Force Aerospace Research Pilot School, Edwards Air Force Base, Calif.

In 1965, Truly became one of the first military astronauts selected to the Air Force's Manned Orbiting Laboratory program in Los Angeles, and he transferred to NASA as an astronaut in August 1969. He served as capsule communicator for all three manned Skylab missions in 1973 and the Apollo-Soyuz mission in 1975. As a naval aviator, test pilot and astronaut, Truly has logged over 7,500 hours in numerous military and civilian jet aircraft.

He was pilot for one of the two-man crews that flew the 747/Space Shuttle Enterprise approach and landing test flights during 1977. He then served as backup pilot for STS-1, the first orbital test of the Shuttle. His first flight in space was Nov. 12-14, 1981, as pilot of Space Shuttle Columbia (STS-2), significant as the first manned spacecraft to be reflown in space. His second flight (STS-8, Aug. 30-Sept. 5, 1983) was as commander of Space Shuttle Challenger, the first night launch and landing in the Shuttle program.

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On Jan. 18, 1989, Truly was awarded the Presidential Citizen's Medal by President Reagan. His NASA awards include two NASA Distinguished Service Medals, the NASA Outstanding Leadership Medal, two NASA Exceptional Service Medals and two NASA Space Flight Medals. His military decorations include the Defense Distinguished Service Medal, the Defense Superior Service Medal, two Legions of Merit, the Navy Distinguished Flying Cross and the Meritorious Service Medal.

Truly also has received the Robert J. Collier Trophy (twice, 1982 and 1989), the Robert H. Goddard Memorial Trophy (twice, 1982 and 1989), the Society of Experimental Test Pilot's Ivan C. Kincheloe Award (1978) and James H. Doolittle Award (1988), the Federation Aeronautique Internationale Gold Space Award (1984), the Harmon International Trophy (1982), the Thomas D. White Space Trophy (1982), the American Institute of Aeronautics and Astronautics Haley Space Flight Award (1980), the American Astronautical Society's Flight Achievement Award (1977) and John F. Kennedy Astronautics Award (1990), the Air Force Association's David C. Shilling Award (1978), the Boy Scouts of America Distinguished Eagle Scout Award, the Medal of Honor of the National Society of the Daughters of the American Revolution and the Sons of the American Revolution Gold Good Citizen Award.

Truly was born in Fayette, Miss., on Nov. 12, 1937, and attended school in Fayette and Meridian, Miss. He is married to the former Colleen (Cody) Hanner of Milledgeville, Ga. They have three children and three grandchildren.

- end -

Revised April 1, 1990

NASA
National Aeronautics and Space Administration
Washington, D.C. 20546

Biographical Data

JAMES R. THOMPSON JR.
NASA Deputy Administrator

James R. (J.R.) Thompson Jr. became deputy administrator of NASA on July 6, 1989, following 33 months as head of the Marshall Space Flight Center, Huntsville, Ala. During that period, the multifaceted Marshall Center oversaw the redesign and testing of the Space Shuttle's critical solid rocket boosters. The success of that effort was a prerequisite to NASA's "return to flight" on Sept. 29, 1988, when the Space Shuttle Discovery was launched on the first Shuttle mission in almost 3 years.

Before becoming Marshall director on Sept. 29, 1986, Thompson served 3 years as deputy director for technical operations at Princeton University's Plasma Physics Laboratory, Princeton, N.J. From March to June 1986, he served as the vice chairman of the NASA task force inquiring into the cause of the Space Shuttle Challenger accident. In that capacity, he headed the day-to-day operations of the 51-L Data and Design Analysis Task Force, which collected and analyzed information in support of the Presidential Commission on the Space Shuttle Challenger Accident.

Previously, Thompson spent 20 years with NASA at Marshall in various positions, including associate director for engineering in the Science and Engineering Directorate and manager of the Space Shuttle Main Engine Project in the Shuttle Projects Office.

Thompson joined the research and development team at the Marshall Center in 1963 as a liquid propulsion system engineer responsible for component design and performance analysis associated with the J-2 engine system on the Saturn Launch Vehicle. In 1966, he joined the Space Engine Section in the former Propulsion and Vehicle Engineering Laboratory and became chief of the section in 1968. In that capacity, he was responsible for the design and test evaluation of auxiliary space engine propulsion systems for the Saturn Launch Vehicle and experimental small interplanetary propulsion systems.

In 1969, Thompson transferred to the former Astronautics Laboratory where he served as chief of the Man/Systems Integration Branch from 1969 to 1974. In September 1974, he was named manager of the Main Engine Projects Office. In that position, he was responsible for the development and operation of the most advanced liquid propulsion rocket engine ever developed. He served in that capacity almost from the beginning of early development testing on the Shuttle main engine through the initial Shuttle flights.

- more -

In February 1982, Thompson was named associate director for engineering in the Science and Engineering Directorate. In this position, he was responsible for planning and executing the engineering overview, analysis, evaluation and support for all Marshall projects that were in the hardware development stage.

Born in Greenville, S.C., Thompson graduated from Druid Hills High School, Atlanta, in 1954. He was awarded a bachelor's degree in aeronautical engineering from the Georgia Institute of Technology in 1958 and a master of science degree in mechanical engineering from the University of Florida in 1963. He also has completed all course work at the University of Alabama toward a Ph.D. in fluid mechanics.

He served as a lieutenant in the U.S. Navy from 1958 to 1960 and was stationed at Green Cove Springs, Fla., as an administrative officer in the Atlantic Fleet.

Thompson began his professional career in 1960 as a development engineer with Pratt and Whitney Aircraft, West Palm Beach, Fla.

He is a member of the American Institute of Aeronautics and Astronautics, Sigma Nu social fraternity and Sigma Xi professional society.

Thompson was awarded the NASA Medal for Exceptional Service in 1973 for his work on Skylab, and NASA Medals for Distinguished Service in 1981 for his work on the Space Shuttle main engine and in 1988 for his work on the 51-L Data and Design Analysis Task Force. Twice, in 1982 and 1987, was awarded the rank of Meritorious Senior Government Executive. He was one of five members of NASA's Return to Flight Team awarded the Dr. Robert H. Goddard Memorial Trophy for 1989.

- end -

August 1989

August 1, 1990

THOMAS CAMPBELL
COMPTROLLER
BIOGRAPHY

Mr. Campbell was named Comptroller in early spring 1987. Prior to this, he served as NASA's Deputy Comptroller since 1979. He joined NASA at the Goddard Space Flight Center in 1959 as an administrative assistant in the Satellite Applications Systems and Projects Division. He came to Headquarters in 1963 and has worked in the resources area since that time.

Mr. Campbell received a Bachelor of Arts degree from Harvard University in 1955. He served in the U.S. Air Force from 1955 through 1959 prior to joining NASA. He has received the NASA Exceptional Service Medal twice and in 1982 and 1988 he received the Meritorious Rank Award and the Distinguished Senior Executive Award in 1989.

The CHAIRMAN. Thank you very much, Admiral Truly. Do either of your colleagues wish to add anything to what you have said?

Mr. THOMPSON. No, Mr. Chairman.

The CHAIRMAN. You are just there to handle the hard questions that he cannot answer? [Laughter.]

I am going to recognize our ranking minority member, Mr. Walker, first. Then I am going to recognize members as best I can in the order in which they appeared, beginning with Mrs. Collins who appeared 10 minutes before the committee started. I want to provide reinforcement for that kind of initiative. [Laughter.]

Mr. Walker.

FUNDING OF NATIONAL AEROSPACE PLANE

Mr. WALKER. Thank you, Mr. Chairman.

Just to reemphasize a point that I think I understood from your testimony with regard to the National Aero-Space Plane—the amount of money which is in the budget for this year is a sufficient amount to support a 1993 decision on proceeding to build two X-30s; is that correct?

Admiral TRULY. That is correct, Mr. Walker. We believe that this money is adequate to define the phase of the program that we are in that will allow DOD and NASA to recommend whatever is appropriate at that time and allow a decision to move forward into development.

DEFINING THE EXPLORATION BUDGET AND TECHNOLOGY BUDGET

Mr. WALKER. Just so I can understand your thinking a little bit—when I look at the exploration part of your testimony, you list some of the things you are going to do and a lot of them are in the technologies area: space surface, nuclear power, space nuclear and advanced cryogenic propulsion, life sciences and life support technologies.

Why are you supporting that under the exploration budget rather than under the technology budget since most of these are technology areas and do not directly relate to exploration. I understand the need for them in exploration, but why the decision to basically budget them under exploration rather than under a more robust technology program?

Admiral TRULY. I believe that in the budget book, it is in fact carried under the technology program. I chose in my statement and my description to highlight the need for those technologies because, no matter which architecture we choose to do the exploration program, it is those technologies that are required whether the launch vehicles are big or small. And no matter what route we would take, we will need things like life support, life sciences, and the things that you mentioned.

Mr. WALKER. The reason I asked the question—the chairman and I were just talking here—is because of the nature of the political process here. You are more likely to get support for those programs under your basic technology program than you are maybe in the advanced exploration program. I just wanted to make certain that, as we are dealing with some of these, that we recognize that the political climate may be such that we want to enhance the technol-

ogy program on some of those rather than putting all of our eggs into the exploration basket.

You have also indicated that you intend to appoint an Associate Administrator for Exploration. Can you give us a little bit of your thinking about that and how you think that is going to proceed?

Admiral TRULY. Yes, I did make that decision. First of all, it was a recommendation of the Augustine committee. It was an organizational configuration that we were in early on some years ago, as a matter of fact. Before Christmas, I made a decision, both on the AA for Exploration and the AA for Human Resources because I thought that in both of those areas we needed to make sure that it was clear that they had the visibility in the agency for the planning that was required.

We have a number of very talented people within the agency that I believe would do an excellent job as an AA for Exploration. However, in order to make sure that we looked outside of NASA as well, both in the university community and the industry community and other agencies, we have decided to do, what we call in government, to advertise that job.

I signed off on the paperwork a couple of days ago. It is on the way over to OPM. We intend to have a nationwide announcement for the AA for Exploration in two or three weeks, I think.

For this stage of the program, which is principally a planning stage in the next few years, looking at mission studies, looking at choices, looking at technologies—I think that is the way to get the best focus and to get the best visibility on the part of J.R. and me as we move forward.

Mr. WALKER. I am somewhat concerned about the mission we are giving that person, from the standpoint of reading the Augustine report. The Augustine report indicates that the exploration program ought to be on a pay as you go basis. There have been at least some questions raised about whether or not the resources and the political momentum that is required to conduct such an ambitious program will ever materialize under such circumstances.

Do you agree with the assessment that it may be difficult to get the resources on that basis, and secondly, is this something that you are talking to potential people that you might bring into the job about?

Admiral TRULY. I would certainly agree with you that it will be difficult to get resources for many parts of our program including this one. However, I think that for the long range focus for the direction that the Nation is going to head in the next century for the space program, that it is appropriate to have a job in the agency that has a very long-range focus and can think about and plan the robotic and the human exploration of the solar system over those long years.

Yes, there are many parts of our budget that require an excellent articulation on the part of us in the agency and support of the Congress, but just because it is hard to get the resources, I am not in favor of not making the argument to get them because I think it is precisely the right direction that America's civil space program should go.

Mr. WALKER. Thank you, Mr. Chairman.

The CHAIRMAN. Mrs. Collins.

Benefits from Space Exploration

Mrs. Collins. Thank you, Mr. Chairman.

Admiral, your report is very good and clear. It gives me a lot of information as a new member on the committee. I have two questions.

The first is—last week, I believe, we had the hearing on the Augustine report. One of my colleagues asked how we could justify space exploration when there were so many domestic programs in need of money.

I know that there is a lot of benefit to the community and the commercial industry from space exploration. Do you have a list of those? Has anyone compiled the medical and commercial benefits that we have received? I do not want you to give them today, but do you have them?

Admiral Truly. I understand. Yes, we do make an effort to compile benefits of the space program. We publish documents each year as to technology that has been transferred into the private sector. We had an extremely successful effort this year here in Washington, a Technology 2000 Conference, which really stunned me as to the number of people from private companies and particularly small companies that came to discuss this particular issue.

I cannot help but take this opportunity to say that the NASA programs are an investment in the future. They provide a major number of jobs in this nation and they are the kind of jobs—engineers, scientists, researchers—that communities form around.

Our programs probably have one of the major benefits in the country as far as economic growth, both in aeronautics and in technology. We continually need to do a better job in transferring this technology into the private sector. That is why it is an emphasis.

Mrs. Collins. Would you forward to me a compilation of some of these?

Admiral Truly. We would be pleased to provide to you the kinds of things we do so that you could understand us a little better.

Mrs. Collins. All right; thank you.

Education Emphasis

My second question—you spoke of the special emphasis on education, and I know that you are asking for a 17 percent increase for academic programs. You want to encourage young students—at what grade level?

Admiral Truly. We have programs that span all the way from preschool in some cases through K–12 and all the way through to the universities. Our educational programs, of which there are many individual programs, have three principal thrusts.

The first focus is to capture young people at the earliest possible age to try to make sure that they are not scared of math and science.

Mrs. Collins. Is that elementary level?

Admiral Truly. Yes, in elementary, particularly in the younger grades. As a matter of fact, I had lunch yesterday and met with the President of the American Federation of Teachers and also with the chancellor of one of our major Historically Black Universities and Colleges in the country.

We are putting a great deal of emphasis toward making sure that our educational programs and the meager dollars, frankly, that we do have, because they are less than some other agencies, are properly focused to the national goals and to the needs of teachers and schools. We would love to tell you more about those programs, too.

Mrs. COLLINS. Will that be in the form of grants directly to the school districts? You mentioned tools in the hands of teachers. I would like to know if those will be given directly to each district or do they go through the State, and are they nationwide?

Admiral TRULY. They vary, but generally, they are not direct dollar grants to school districts. What they are, for example, is the development of curricula for second graders or third graders that can be distributed throughout the Nation to allow teachers to have better ways of communicating to very young students the excitement and the value of exploration of science and so forth.

Depending on at what level in the school system you are, these focused programs take very different directions. For example, if it is a second grade curriculum, it would be one thing. If it is part of the program that tries to channel high school students to not give up on math and science but to continue in the pipeline, it would be very different.

Mrs. COLLINS. I know I am out of time. I just want to ask if you would consider direct grants? Many of the inner city schools cannot afford to hire science and math teachers. You might have history teachers teaching science or physical education teachers teaching math. I think that the students in our major cities need more direct financial help in hiring the teachers who can really get the students interested in these very technical subjects.

Thank you.

The CHAIRMAN. Mrs. Collins, I should point out that learned recently that there has been a nonprofit foundation set up called the Challenger Center, I guess it is, which supports the Challenger Centers which are set up to pursue the cause of space-based education resulting from the Challenger crash and the death of the school teacher in that.

That program has been going on for a few years, and there is a local center within commuting distance right here in Maryland which I plan to go out and visit one of these days. Maybe we could both go out and see the kinds of things they are doing out there.

Mrs. COLLINS. Yes, I would love that.

The CHAIRMAN. Mr. Rohrabacher.

ALS AND HLLV

Mr. ROHRABACHER. Thank you, Mr. Chairman.

Admiral, if you will allow me to just focus in on one specific area of your fiscal year 1991 operating plan—let me read part of that to you. That is pages one and two under Space Transportation Capability Development, the second paragraph. "Leaving $13 million for Advanced Launch Systems, ALS, and $10.5 million for Shuttle-Derived Heavy Lift Launch Vehicle studies, HLLV studies."

Now, is this basically what we are talking about in your heavy lift studies, ALSs and shuttle-derived HLLVs?

Admiral TRULY. Since Mr. Thompson has been directly involved more than I with DOD, I might let him help me respond, but that is the 1991 program upon which we are building our initiative or the options that are in our initiative based on our previous studies of shuttle-derived and advanced launch systems.

Would you comment?

Mr. THOMPSON. I would just add, as you well know, the ALS study work that we have had ongoing with DOD is now in about its third year. Taking off of the Augustine report, I think we are more converging with DOD in terms of a common downstream system.

I think that as we proceed through this year, we are probably going to merge the activity that was set aside for the Shuttle C work with the ALS money. I think you are going to see a common program and, probably what we end up with is going to be a little bit of what has been looked at in terms of the real down-streamed technologies on ALS as well as capitalizing on some of the near-term work that has been studied on the Shuttle C activity.

Mr. ROHRABACHER. Let me get right to where I am trying to go here. Having looked at your operating plan, I find it a little bit inconsistent with what we, frankly, put forward in the Authorization Act.

Let me read you a part of the Authorization Act. "Of such funds, $10 million shall be used for supporting heavy lift launch vehicle studies which shall include study of commercially developed variances as well as other appropriate concepts rather than studying shuttle-derived heavy launch vehicles alone." I wonder if you could—are we actually studying as it says here, rather than studying shuttle-derived heavy launch vehicles alone? Am I missing something here in your own report?

You have an operating plan here but it does not seem, from what I see, to include any money for the study of heavy launch vehicles other than shuttle-derived vehicles. Am I missing something in your plan?

Mr. CAMPBELL. Of the total of the $23 million, $13 million is directed toward the heavy lift version. At that time we were using the designation of the ALS system.

Admiral TRULY. But let me assure you that we are not limiting our options or our studies to only shuttle-derived. As you know, for example in the advanced launch system with DOD, we have started making the initial efforts toward the development of a new engine that is not a shuttle-derived capability, and we are not limiting out options in any manner.

Mr. ROHRABACHER. So you are saying that the non-shuttle-derived heavy launch vehicle studies are all encompassed within your advanced launch system studies? Is that what you are saying?

Mr. CAMPBELL. That is correct; yes, sir.

Mr. ROHRABACHER. Do you think that it was the intent of Congress perhaps that you should be studying other things other than those two? Maybe some of the other members will correct me, but having just gone through this, it seems to me that our intent was to have you study other heavy launch vehicles outside of those two.

Mr. THOMPSON. I would just comment that the ALS program has a wide range of capabilities. It is not just a specific vehicle design. It is a wide range all the way from vehicles that are more in the

shuttle class than the Titan 4 going all the way to heavy lift that is well in excess of 100,000 pounds.

Mr. ROHRABACHER. My time has run out, but I am going to pursue this with you perhaps next week, and we can do this outside of a hearing.

Mr. THOMPSON. Sure; yes, sir.

The CHAIRMAN. The Chair would just like to reemphasize that NASA is not in a position at this point to give us a more or less final response on two critical questions: the new launch system, which as you indicate is one that covers a broad range of lift capabilities, and the reconfiguration of the space station. The subcommittee will have to go into those with you in a timely fashion.

Mr. Thornton.

EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH

Mr. THORNTON. Thank you, Mr. Chairman.

Pursuing for just a moment that question on hardware—I asked at a hearing a few days ago if consideration had been given to the capabilities of the Saturn 5 heavy lift capability. Subsequent to that, I have learned that we do have some of those motors still in existence and maybe some plans. I hope that that will be given some consideration and that we may pursue in due course whether this very reliable, extremely heavy lift capability, a quarter of a million pounds or so, might have some function at least until a new and more efficient driving or engine system is designed and constructed. If you had comments on that, I would be pleased to hear them, although I think it is a matter that we should explore probably by reviewing it and by consultation instead of right now.

The other question I have is on software. That is, I would like to applaud your emphasis upon education. I would like to inquire whether you are giving consideration in those educational programs to developing the broad base for education which often produces unexpected results.

A few years ago, with the leadership of this committee, the National Science Foundation developed a program called the EPSCOR, Experimental Program to Stimulate Competitive Research. It happened to arise out of a conversation between me, as chairman of the subcommittee at that time, and Dick Atkinson who was head of the NSF.

My question is whether you are giving attention to the resources of the historically black institutions which Mrs. Collins referred to and to areas of the country where research is available but has not yet reached the levels of competitive research in your programs. Let me give you one quick example of the benefits of this program.

As a result of the EPSCOR program, the world's highest-temperature superconducting material is the result of Dr. Alan Herman and Gingik Chiang operating at a not well known research institution, the University of Arkansas. Those patents are in large part the result of the EPSCOR program, and I wonder if you are paying attention to that in your development of software for support of the Nation's research capability?

Admiral TRULY. Let me comment if I may on both those issues, but let me take the education issue first. As a matter of fact, we

have a program that is patterned directly after the EPSCOR programs where we just two or three days ago announced a new selection of States across the country in our Space Grant college program that is patterned directly after EPSCOR.

This provides grants directly to consortia of colleges and universities in a number of States—we would be glad to provide them to you, and even some money to some States that, frankly, have not had within their State educational system these types of aerospace education programs, and we are helping them.

The Space Grant College and Fellowship Program has been underway now for the last two to three years. A number of the first set of colleges and universities have made some tremendous progress. I have been to two or three of them and heard what they are doing, and it is a good program.

Let me comment briefly on the Saturn 5 even though you did not ask a specific question about it. We have taken a look at the Saturn 5 program and there is a myth that I have read in the newspaper that in fact we no longer have the drawings, the plans, and so forth.

Mr. THORNTON. Sir, that was the result of the question here in this committee, and I am glad to have the record set straight.

Admiral TRULY. Yes; in fact that, however, is not the case.

There are problems, however, in moving back to the Saturn 5. First of all, it is expensive. It is 30 year old technology, even though we have the plans, the drawings, et cetera, and some hardware. The infrastructure itself has been abandoned, the fabrication plants, the launch pads, and so forth.

The other comment that I would make is that Saturn 5, even though an unbelievably capable program, was a point-designed booster. It was not the type of launch vehicle that could serve a variety of missions for the DOD and NASA, but we have looked back at it and continue to.

Mr. THORNTON. Thank you, Mr. Chairman.

The CHAIRMAN. Mr. Rhodes.

SOLAR DYNAMIC POWER FOR SPACE STATION

Mr. RHODES. Thank you, Mr. Chairman.

Admiral, I want to question you on a subject that has sometimes been perhaps the subject of a little friction between the committee and NASA. That is the issue of solar dynamic power for the Space Station.

As you know, the committee has long been interested in the development of solar dynamic power and I would have to say that perhaps NASA's interest has not been quite as keen as the committee's. Everything that we are aware of seems to indicate that at some point in time, because of life cycle costs of the photovoltaic systems and so forth, we are going to have to use some form of solar dynamic power on the station.

Last week, the chairman and Mr. Walker did send you a letter indicating that last year's authorization act required that you submit a plan for a flight demonstration by May 1 of this year and noting also that the appropriations bill of last year fenced off $10 million for that flight demonstration. Can you tell us if we are

going to get the plan on time and if it will in fact deal with how you intend to use the money that has been set aside solely for this purpose?

Admiral TRULY. You are right. The issue of technology investments in solar dynamic power systems has been one that NASA and the committee have discussed many, many times. The difficulty that we have found ourselves in now is that the levels of reduction in Space Station Freedom in our appropriation from last year, just as a reminder, were $551 million out of the fiscal year 1991 budget and a total of $6 billion out of the five year run-out.

In down-scoping the Space Station in size, not in the quality of the life sciences and the micro-gravity research, but in down-scoping the station in size and looking at the power requirements for the users, we have simply found in that restructuring that the Space Station program as it is turning out simply does not have a programmatic requirement at this time for solar dynamic power. So we are doing two or three things in parallel. We are trying to finish that restructuring and prepare to answer the committee by May 1 as to how we would address the issue of this technology.

And, yes, we do intend to communicate to the committee if we can or, if we cannot, communicate with the committee to get an extension. We intend to respond by the first of May as to what we would need to do with that particular issue.

Mr. RHODES. I was thinking that I could anticipate that a portion of your response is going to be some sort of an explanation that you do not think that it would be cost effective or necessarily even productive for you to even do a flight demonstration. Is that accurate?

Admiral TRULY. A recommendation for a decision does not even come to me on this particular issue, but I would say that that is my sense with regard to the restructuring.

Dr. Lenoir is here who is the AA for Space Flight that has the Space Station restructuring effort going on. I might ask him to come up and comment if he would.

Dr. LENOIR. As Admiral Truly said, the restructuring assessment is continuing. We are in the tail end.

As we had maintained for some time, to grow this Space Station power beyond about 75 kilowatts with the initial photovoltaic arrays does not make a lot of technological sense. It was in order to grow past 75 kilowatts on board power capability that we identified solar dynamics as the most logical solution. It is to solve that problem that we have focused on solar dynamics.

As we restructure the Space Station and try to stay within the overall funding limitations, we find in our preliminary assessments to date that we do not even get to 75 kilowatts by the end of the century. If we marshall all the dollars that we can and do not quite get all of the array sets up to get us to 75 by the 1999/2000 time frame, that then pushes what we are trying to find a name for right now, a follow-on phase or something of that nature, but the requirement for solar dynamics then moves further away from us and into that time frame.

What we are likely to propose is that in the paucity of funding that we will have in the late nineties, we need to focus that on the

front end of the Space Station and the back end will just have to wait until money is available.

Mr. RHODES. My bell has rung, Admiral. I am sure that we will revisit this issue on several occasions. Thank you very much.

Admiral TRULY. Yes, sir.

Mr. RHODES. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Mr. Rhodes.

Mr. Geren.

THE SPACE STATION

Mr. GEREN. Thank you, Admiral, for your testimony.

According to the Augustine committee report, the primary justification for the Space Station is to prepare for human space exploration through life sciences research and verification of long duration space operating systems. Given the low priority they assign to human space exploration over the near-term, could you address the urgency and the need for going forward with the Space Station as it is currently planned?

Admiral TRULY. I believe that the Space Station as it is going to be restructured as a result of this is an investment that should go forward. Even though the Augustine committee, in their view, said that the principal reason was life sciences, there is also a major contribution the Space Station can make in micro-gravity research. As a matter of fact, because of the phases through which we will proceed in the assembly, even though the micro-gravity in my view is not more important than life sciences, we will be doing a great deal of that research earlier than the major life sciences.

I believe that the Space Station stands on the path to any future exploration and it provides the capability in these two major areas that simply cannot be achieved in another rational way considering the investment that we have made and the quality of the restructuring effort.

Mr. GEREN. Thank you, Admiral.

Mr. Chairman, I have no other questions.

The CHAIRMAN. Thank you, Mr. Geren.

Mr. Gilchrest.

MORE ON EDUCATIONAL PROGRAMS

Mr. GILCHREST. I would ask two, one going back to the question on education. You said there were three phases of education, and I think we got through one of them. I wanted to write down the other two, being an educator.

The other one, I suppose, is the one that was just mentioned about the funding for the materials or for life sciences, and it seems to be more for material. Is it that the material funding is a priority now because the construction of the Space Station is so far off?

Admiral TRULY. Thank you for allowing me to finish what I was saying about the educational programs first. We have quite a number of individual programs, but in order to get ourselves, frankly, more organized within the agency, we have done a lot of work to make sure that each of those programs falls into one of three major thrusts.

The first one that I mentioned was programs that are designed to capture young people at the earliest possible age into the program. The second is to then channel as many of those young people as they go through the K–12 grades and keep them interested in math and science related degrees.

If you look at the numbers of students across the years that we lose, it is absolutely chilling the number of students in the various grades who express an interest in math and science and how that decreases throughout the educational system. Third is to help teachers, to put tools in the hands of teachers. We have a number of programs that can do that.

Changing the subject to the question of life sciences research, frankly, our investment in life sciences over the last several years has been one of the largest percentage increases in the agency. I cannot recall—I can look it up quickly—but comparing investment from say 1988, I think it is, to the 1992 budget, it is something like a 250 percent increase in those areas.

We simply are phasing our investments to support the life sciences research that is being done today and in upcoming years on the shuttle, and also phasing the later life sciences to the types of hardware that would support that research aboard the Space Station, which is a number of years in the future.

Mr. GILCHREST. Thank you, Admiral.

Thank you, Mr. Chairman.

The CHAIRMAN. Before I recognize Mr. Volkmer, let me ask you just one thing, Admiral.

I had read the earlier FCCSET report on education and I am impressed by the role played by two admirals, you and Admiral Watkins. Did you have an opportunity to discuss with him, during the completion of that report, the common problems that you face in your two agencies and ways that you might cooperate in approaching those problems?

Admiral TRULY. I have had hours of discussions with Admiral Watkins about education and math and science education. I supported him when he and Dr. Seborg out at Berkeley put together a math and science education conference, an action conference. Many of the initiatives out of that effort are represented here in this FCCSET report.

He is the Chairman of the Education and Human Resources Committee—I think that is the right name of it—of the FCCSET. We probably have closer relations in education with the Department of Energy than any other single department because we are very similar to them in many ways.

We have about nine NASA centers around the country dealing with technological efforts, and the Department of Energy, of course, has the national labs also around the country. We are very fortunate in many cases that they are in different cities so that Fermilab or Los Alamos can take the output of our educational program when we give it to them and reach people we could not reach and vice versa.

The CHAIRMAN. Thank you.

Mr. Volkmer.

Estimated Starting Date For Space Station

Mr. VOLKMER. Thank you very much, Mr. Chairman.

Dick, when do we now plan to start putting Space Station Freedom up?

Admiral TRULY. If you recall, the baseline program prior to the large cuts had the first assembly flight in, I believe, the Spring of 1995, March of 1995. If something does not change in the next 30 days before we bring this report to the Congress, that flight will be later in 1995 but will remain in that same year.

Mr. VOLKMER. All right. Now, it will take approximately what time frame in order to have it fully assembled and operational?

Admiral TRULY. The first use of the Space Station will be available in about a year after we start assembling for micro-gravity research. I think 13 or 14 months. With the stretched out budgets, the first capability to leave people permanently on the station will be just before the end of the decade.

Mr. VOLKMER. The reason I ask these questions is because there are some of us—others brought it up starting with the question: what are we going to use as a transportation vehicle? All we have right now basically is the shuttle; agreed?

Admiral TRULY. That is correct.

Mr. VOLKMER. At the same time, we are now starting on a new launch system and I know that study has yet to be completed. Do you agree, or maybe Mr. Thompson can agree or disagree, but when I look at this, if I am going to have additional transportation to provide assistance to the shuttle for the Space Station, is there anything other than a Shuttle C or a derivative from a Shuttle C that could be available in that time frame?

Mr. THOMPSON. I would just comment not in that thrust class. Certainly there are a lot of smaller ELVs, but with the size of equipment we are talking about on the Space Station, it is the Shuttle earlier, but it does not evolve as gracefully as the Shuttle C. What we are working together on with the DOD is about at the turn of the century with 1999 being somewhat of our target date, but that work is not complete.

Mr. VOLKMER. Between 1995 and 1999, if I develop a whole new heavy lift capability vehicle, I am not going to be able to use it to assemble the Station?

Mr. THOMPSON. Unless you take off more on what we have already got which is the Shuttle C. It is as simple as a new engine.

Mr. VOLKMER. I agree. I am not disagreeing. I agree, but I want to think it through as to where we are going.

If we in the Congress decide that we are going to need something besides just the shuttles, or should have something besides the shuttles, than somewhere along the line we are going to have to make this decision. I keep coming to the conclusion that I do not know of anything I can do besides the Shuttle C or a derivative thereof. Do you agree or disagree with that?

Mr. THOMPSON. Well, I think that in terms of the time frame you put it in, I think that is exactly right. Any time you take off and try to develop a new engine, you are looking at lead times that put the launch vehicle in the 1999 time frame.

Mr. VOLKMER. Right.

Mr. THOMPSON. So I think we have to arrive at a consensus as to what we really want to do because we have been talking this alternative transportation program now for about three years and we have actually retrenched in terms of dollar priorities. I think we now have a new opportunity with the look of the Augustine group.

Mr. VOLKMER. But even now, if we do not start soon— in other words, we are going to have to get off the dime somewhere along the line or else you are not going to have it ready even if you do a Shuttle C derivative.

Mr. THOMPSON. You are right.

Mr. VOLKMER. I mean, we cannot put it off for another two or three years and start in 1994 or 1995 to develop this heavy lift and use it for the station.

Admiral TRULY. If I might add, I think that is a good observation but I personally do believe that even in 1999, if we brought in an alternate transportation system to complement the shuttle in 1999, no matter what the flavor of that is, it is going to be able to provide a great support over the decades of the operation of the Space Station in logistics and further capability.

Mr. VOLKMER. I agree with that, but if we are going to want to use something other than the shuttle to assemble the station, then I do not think we can wait until 1999 unless you want to wait until late 1997 to start with it. I mean, that is the alternative. We can push the Space Station back far enough and wait for a heavy lift to be developed if that is what we want to use.

Mr. THOMPSON. It took us 10 years to develop the shuttle and it is going to take us at least eight years to develop a new program. If we want it, we have got to get going.

Mr. VOLKMER. Right; but we do not have to take that long if we do the Shuttle C. We have existing technology.

Mr. THOMPSON. That is correct. You can build on what we have. It depends on how you want to try to evolve it. That is really what we are trying to come to grips with now with the other agencies involved.

Mr. VOLKMER. Thank you, Mr. Chairman.

The CHAIRMAN. Mr. Volkmer, thank you, but you are not thinking far enough in the future. You have to realize this Space Station only has a limited life and we have to be thinking about a replacement Space Station. [Laughter.]

Mr. VOLKMER. Mr. Chairman, I do not think I am going to be around to worry about that. [Laughter.]

The CHAIRMAN. Mr. Packard.

Mr. PACKARD. We may not be around, Mr. Volkmer, long enough to see the first Space Station go up. [Laughter.]

I would like to pursue Mr. Volkmer's line of questioning a little bit because that has certainly been on my mind also. Again, let me review it in my mind to make sure that I am seeing clearly to this point.

The heavy lift vehicle that is being discussed would assist, of course, in the payload to construct the Space Station, but we will not have that completed in time to do very much, if any, of the construction work on the Space Station. If we go ahead and decide then to make a new heavy lift capability, what are some of the functions?

You say that there are purposes down the road for which it could be used. What are they?

Admiral TRULY. First of all, I think that it would be quite logical to develop a system that was evolutionary and certainly should initially have the capability of the shuttle system so that we could achieve what the Augustine report and what a number of people have argued over the past years is an alternate method of getting to space and not depending so entirely on the shuttle system. Then that vehicle should be clearly able to evolve into a heavy lift vehicle which is required on every architecture for the exploration program of the next century.

I think that specific missions it would have—it would be available essentially, once it is developed, for any class either DOD or science satellite of the major classes that we are now familiar with and which are now flying. It would be available for station logistics. It would be available for a follow-on station assembly.

I know this committee is very interested in this issue. You expand the capabilities of the Space Station once you get the initial configuration built. I would say that history would repeat itself. When you get the transportation capability, the exploration and the initiatives would certainly be demanding of it.

Mr. PACKARD. Could many of those functions, however, including for Space Station construction and payload, be adapted to upgrading and improving existing launch vehicles, the Titan, Atlas, Delta, and some of the others that we have? Would it be a cheaper and sooner approach to heavy lift capabilities by upgrading existing launch facilities or developing a new capability?

Admiral TRULY. Again, I think I would ask J.R. to comment since he has been a little bit closer to the DOD and NASA options development. Clearly, you can use present capabilities for the payload weights that they provide.

It has the disadvantage that I mentioned a moment ago, however, talking about Saturn, as you think about what the Nation needs in coming decades. That is, you are generally staying with older technologies and not taking advantage of the sorts of cost effective operations you could create with a new system. Clearly, that question does need to be addressed.

Would you care to comment?

Mr. THOMPSON. I will let DOD comment in terms of some of the trades that they have made as they have weighed upgrading the Saturn near the Titan 4 class as they approach the turn of the century. I think it is because of cost and availability of the systems that is motivating them to work with NASA and think in terms of a new launch vehicle system.

I would think that the same would apply to us. We would run into that same problem if we tried to upgrade some of the existing ELVs to the shuttle class.

I think in the payload capability, it is going to be the cost tradeoffs. They have gone through all of that and stood back—that is the way I read them—and now is the time to really invest for what is going to be needed for the next decade.

How Much Influence Did Augustine Report Have On Development of NASA Budget

Mr. Packard. One quick question, if I may. How much access did you have to the Augustine report as you were developing this budget and how much of the report was used in your preparations?

Admiral Truly. First of all, J.R. and I had a number of intense conversations with both Augustine himself and his committee as he was developing the report, so I believe we were able to anticipate some of the thrusts that would be in it.

The report was delivered in early December. Our budget had already been in to the OMB prior to that, but in those next few weeks following it, we were able to use the impetus of some of the Augustine recommendations to be reflected in the President's budget. I believe there are a number of examples of that.

In the President's budget book, if you read the section on science and technology and particularly on space exploration, you will find a number of references where recommendations from the Augustine committee shaped the budget request.

The Chairman. Mr. Browder.

Research and Development Funding

Mr. Browder. Thank you, Mr. Chairman.

First, I would like to express my appreciation to Admiral Truly and Mr. Thompson and Mr. Campbell for their appearance here today. I want all of you to know of my desire—and I think I can express that of my fellow Alabamian, Representative Bud Cramer who is a new member of this committee—in promoting progress in our space program.

I hope you will always feel that mine is a positive ear here in Congress when it comes to NASA's needs. I want to especially express my interest in the Space Station and the heavy lift vehicle and commercial use of space for those of your staff here who are taking notes. The Augustine panel's recommendations outline some solid proposals for the future of these programs, and I look forward to working with you on those.

In the way of comment, I want to note the need to have a vigorous program of promoting shuttle safety through the Assured Shuttle Availability Program, and I hope you share my concern in this area. I have some comments that I would like to make to you later about TDRSS, but I have two questions I would like for you to answer today.

First, could you comment on the level of funding in this year's budget for research and development on new technologies and whether you feel that level is adequate? We have to be looking ahead, not only on what we are working on now, but looking ahead at the future as we develop new technologies. Research and development is one of those things that quite often is shifted over to the side. Would you comment on that?

Admiral Truly. The level in the fiscal year 1992 request for space research and technology is at a level of about $422 million. That is a significant increase from 1991, over $100 million, and represents about a 45 percent increase which is indicative of two things.

One is the continuing high priority that we put on getting those funds. That is the good news. The bad news is the fact that for the last four years, we have continued to make this argument and have been unsuccessful.

We think that the technology program—and we agree with the Augustine report here—has been somewhat starved over that period of time. We hope that we are more successful in the Congress and we need this committee's support to make that point for the future.

Reaching Students Through Academic Programs

Mr. Browder. I hope so, too. I also noticed the increase in funding for NASA academic programs, which you have mentioned. I would like to ask you very quickly—you know, back in the sixties, we had a lot of inspiration for attracting young people. Could you tell us how we are going to attract those young people? You asked for an increase here, but could you compare attracting young people through the academic program today without the mission that was so prominent in the 1960s and whether you think we will be successful in doing that?

Admiral Truly. Let me say that I do not think this program will ever have a program as magical as Apollo, even when we set into place a departure for another planet or to go back to the moon. Apollo was a special program. It was almost a magical program at a time that America needed it.

On the other hand, let me say that I go around and talk to school children and kids and teachers a great deal, and I never met an eight year old yet that remembered Apollo. But I never met one yet whose eyes did not grow wide when you talk about exploration, talk about science, about astronauts, and I think that our programs—we will not get to them through money, although this request will allow us to use some of the tools we can develop. But I think our programs can get to them where we have the avenues to reach them. I really feel strongly about that.

Mr. Browder. Is this blind faith or blind hope, or have you got any reason to believe that we can get to them?

Admiral Truly. I do not think it is blind faith. I see evidence through our programs where we are making a difference in States, in the K–12 grades, and in colleges and universities. I believe the awareness of such an effort over the years will make a difference across the country.

Mr. Browder. Thank you.

Thank you, Mr. Chairman.

The Chairman. Thank you very much, Mr. Browder.

Mr. Lewis.

National Aerospace Plane Funding Request

Mr. Lewis. Thank you, Mr. Chairman.

I would like to make note that you only requested $73 million for the National Aero-Space Plane which was less than last year. I understand, Admiral Truly, that one of the reasons that was given for this lessening of appropriation was by Congressional action.

How did you arrive at the $73 million figure and what Congressional action was involved?

[The information follows:]

The NASA budget statement contains language concerning the reduction of $24 million in the NASA portion of the FY 1991 NASP program (from a requested level of $119 million to $95 million) as a result of Congressional action on the FY 1991 budget request. The FY 1992 budget request for the NASA portion of this program is $72 million. This was the planned program level for FY 1992, and that has not changed.

Admiral TRULY. Thank you, Mr. Lewis. The $72 million request is consistent with our funding split request with DOD. In the DOD for NASP this year, there is a $233 million request for a total government level of $305 million. The run-out of that in the 1993 budget in both agencies is a total of $300 million.

So even though the NASA request in dollar amount is less than it was last year, that was a part of the planned agreement of how we would split the monies. They have a significantly larger dollar input.

One of the principal inputs that we give to the NASP program is people. We have a large number of NASA people at our research centers, as you know, Lewis, Langley, and Ames, that are supporting the NASP program. So I think that even though our budget shows a decrease, the interagency budgets show the commitment that we made last year.

Mr. LEWIS. Was there any Congressional action that required you to make any changes in your budget? This was noted in the budget request.

Mr. CAMPBELL. The Congressional action, I believe, was in 1991. There was an adjustment in our request down to the $95 million.

Mr. LEWIS. I am completely familiar with the 1991 problems. Is that the action you were referring to?

Admiral TRULY. Could I take that question for the record so that we can make sure that we can research the information that we gave you to make sure it is accurate and complete?

Mr. LEWIS. Certainly.

COMMERCIAL SPACE APPLICATIONS FUNDING

I have one other item, Admiral Truly. You have requested $118 million, which is nearly double last year for commercial space applications. Can you share with us quickly where this money will be spent, and is this a signal that NASA's previous support, sometimes lukewarm to commercial space, is changing?

Admiral TRULY. I will not comment about a previous NASA but I can tell you that the present NASA is taking a number of initiatives to make sure that our support for commercial space is clear and vigorous, although prudent, because at one time or another, I have heard some ideas that I could not support.

The major increase, I believe, in the 1992 budget is a reflection that we are meeting a transportation commitment that we have made to investors in the—not investors—but to the CCDS program and to flight hardware and experiments that we placed seed money in in previous years which is now coming into fruition.

The other major parts of the increase are, for example, the CMAM.

Mr. THOMPSON. That is the carrier for the CCDS output so that now we can give them a ride on a shuttle and return their microgravity experiments predominantly back to their laboratories.

Admiral TRULY. And there was a competition that was won by Spacehab. We negotiated a contract with them and as a result of that, this request meets our commitment on that contract. We are not shying away from the possibilities of commercial space at all.

Mr. LEWIS. There is one other area that I have some concerns about. If you have a deletion in your funding, you have already prioritized those areas and you will make reductions; is that correct? Let's say in the final analysis when the appropriations bill passes, you have a deletion in some of the funds that you have requested. Have you prioritized what areas you will make any reductions in?

Admiral TRULY. No; I believe we need $15 billion, $750 million this year. No, I have not made any prioritization assuming any degradation of the budget as of now.

Mr. LEWIS. Thank you, Admiral.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Mr. Lewis.

Mr. Tim Roemer.

ANALYZING—COST EFFECTIVENESS AND RELIABILITY OF LAUNCH SYSTEMS

Mr. ROEMER. Thank you, Mr. Chairman.

Admiral, Mr. Campbell, and Mr. Thompson, I appreciate your expertise and your time here today. As a new member, I have learned a great deal today.

Admiral, I would like to ask you a question from somebody hot off the campaign trail here, having gone to 20,000 doors door-to-door in my district. So many of the people in the Midwest where I come from do not really think and have a lot of confidence in many of the programs and how effective we are being with the tax dollars.

One of the reasons and one of the things we are learning in the Persian Gulf, I think, with some of our defense equipment, particularly with the B-52 and with the F-15A going to the F-15 Eagle, the B-52 being modified and redesigned over the decades, is that they are seeing some productivity and some safety and effectiveness there.

I guess my question comes back specifically to getting our dollar's worth, getting safety, getting cost effectiveness and reliability out of a system such as the Delta and the Atlas and the Titan. What very specific things have you looked at in terms of analyzing and critiquing the costs there? How long into the future might those systems be able to provide heavy launch capabilities? How much critical analysis has gone into that?

Admiral TRULY. Well, clearly those systems and others that we operate have served us well and they continue to, and the Nation has invested in upgrades to them. For example, the Delta 2 rocket that is operating today out of Cape Canaveral is a far more reliable, more robust system than the original Delta that was originally developed by NASA at the start of the program.

The same is true for the Titan class. The same is true for Atlas. But the fact is that this country has not developed, as an example, a new rocket engine for space in almost 20 years. Committee after committee and administrator after administrator has pointed out the need to start looking at the investments in new technology and launch systems, and we see an opportunity with the recommendations of the Augustine report and our own judgments to build on the work of the last two or three years to try to begin to move to some of those new technologies.

Your comment about the success of technology in the conflict is well taken. It is a success that, in my opinion, is built on past investments, continued product improvement on existing systems, and tremendous leadership in tough times as leaders in the DOD and the Services have stuck by their guns and won the approval of Congress to get those systems on the line, and I think that that investment is showing today. I believe likewise that investment in the space program will show that our past investments are showing today and our investments this year and in this general time frame will show in the next century.

Mr. ROEMER. Let me ask a follow up to that. In terms of not only modifying and redesigning existing equipment to get reliable equipment and productivity, what can we do in terms of your last comment, improving our dual usage for the private sector for commercialization, for what this committee is going to look at more and more? We just formulated a new subcommittee on competitive technologies. How do we combine, whether it be DOD and NASA or encouraging private sector use, the NASP—how do we see this coming into putting the United States back in as the strongest economic power in the world going into this new century?

Admiral TRULY. Frankly, I think that NASA has two big jobs to do, and we are trying to get going and put more emphasis on both of them. One is a better technology transfer program so that we can make available and just make aware of the technologies that are being developed in the government to the small companies and to the companies that might be able to turn those technologies into products that are competitive, and we are trying to do that.

The second thing that I think is important—there has already been some discussion here this afternoon about it—is for us to take a more serious and constructive look about the commercial space industry. Frankly, those ideas of commercial space are in their infancy. The whole space program is only 30 years old and other than commercial satellites, most of the commercial ideas are barely out of the egg.

We need to develop policies, develop programs, and develop attitudes within NASA and within the companies so that we can communicate better, and they are going to have to take some risk as we do this because subsidizing every idea is impossible for us. Not only is it against national policy, but we could not garner enough dollars if that was the way we were going to go about it.

I think that in those two basic areas, we have made some progress. And we are sure going to try to continue to.

Mr. ROEMER. Admiral, I just want to say thank you once again for your answers. As a member of the Education Committee as well, whenever you can talk about science and math education to

our K-12 kids and use your position to encourage them to get into these areas, I think they are ready to listen to it. I think they are going to be receptive more and more.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Mr. Roemer.

Ms. Morella.

PERSONNEL

MRS. MORELLA. Thank you, Mr. Chairman, and thank you for the series of meetings on the Augustine report and this culmination.

Welcome, Admiral Truly, Mr. Campbell, Mr. Thompson. You can see the enormous interest of this committee and the American people.

So much has been talked about in terms of education and in terms of what can be done with our young people. I just want the record to show that you did come to Montgomery County, Maryland and did speak to a magnet school which had the so-called middle school as well as high school students who are involved in math and science. They are still talking about it.

I think that you do not have the time to do this at all of the schools, but indeed if you could have emissaries with a road show, too, in conjunction with math/science teachers, I just really think that, accompanied with the films you had, that this was really a great program. I have certainly heard good vibes on it.

I also agree that the time to get kids involved really is even earlier than that. It really is in the elementary school when so often they get turned off or do not get turned on.

My questions have to do with personnel. I noticed in the Augustine report that a good segment has been said about what needs to be done with recruiting and retaining, some specific suggestions to NASA in terms of rotating some of your mid-management executives, and the idea that you have available to you now the Federal Pay Comparability Act of our last session.

Earlier than that, you had available a Space Act that gave you some latitude, too. Some of the questions have to do with what you are doing in that regard because personnel has got to be the key to an effective space program.

I noticed also that you issued a press release back in January where you indicated that you were meeting with OPM, the Office of Personnel Management, to discuss some of these issues. I would like you to share with us as you can what you have been doing, what you plan to do, and then ultimately, what more we can do in that regard.

Admiral TRULY. The committee did point out that people are number one; that we cannot have a space program without quality people that we can both attract and retain. Frankly, the Augustine committee was pessimistic that with the pay scales and so forth that we were going to be able to continue to attract and retain the people over the years that they believed we needed. Therefore, they made a number of recommendations.

I have personally discussed and met with and swapped letters back and forth with Ms. Connie Morella who is Director of OPM——

MRS. MORELLA. You mean Connie Newman, not me.

Admiral TRULY. Pardon me—Connie Newman. I would like to say for the record that she and OPM, as far as in the last year and a half with NASA, have been extremely cooperative with us in developing these programs.

I believe, frankly, that we do have flexibilities in the Pay Reform Act that you mentioned that we need a little shelf life on to understand whether or not future legislation would be required, because in that act and also in the Space Act, NASA does have flexibilities that some other agencies do not have. In some cases, I do not think that we have been using all of them to the hilt, and that is an example of the kinds of things we are working with OPM on.

One of the things that I am doing is to name a new Associate Administrator for Human Resources who will have as a sole responsibility the dealing with people issues in NASA. We have not selected an individual for this job yet, but whoever he or she is, I can assure you that that will be their number one and sole responsibility in working with the Congress, OPM, and OMB on the regulations that implement those things.

MRS. MORELLA. I hope you do not have any trouble recruiting.

Admiral TRULY. No, as a matter of fact, I do not think we will. I had hoped to name somebody already but have been unable to. I think it will make a real difference, and frankly, that is not slowing us down at all.

Let me also say that I really did enjoy going out to Montgomery County that day at the magnet school. It was more impressive to me than it was to the young people.

TURNING NASA CENTERS INTO FEDERALLY FUNDED R&D CENTERS

MRS. MORELLA. They really did enjoy it and the teachers did, too. It meant a lot in terms of the inspiration, the proximity, and that people cared.

I wondered what you think about the idea, the pros and cons of turning the NASA Centers into federally funded research and development centers?

Admiral TRULY. That was an issue that was also brought up by the committee as a last resort. Frankly, I think that is a proper way to put it because I think it would be very difficult for any number of financial or political or civil service regulation reasons, very difficult to take one of our centers that employs 3,000 people and to shift it to a different model of an FFRDC. I am not saying it is impossible, but I think it would be very, very difficult.

Some of our centers would be amenable to that and some, frankly, would not. However, what the committee said was that we should look at the flexibilities provided by the Space Act, look at the flexibilities in the new Pay Reform Legislation, work with OPM to make sure that NASA gains the maximum flexibility that we are able to attain, and only if those thrusts did not work, should we pursue that idea.

MRS. MORELLA. Thank you very much.

Thank you, Mr. Chairman.

We certainly wish you success for all of us and for our country in NASA.

The CHAIRMAN. It is my pleasure now to introduce the distinguished gentleman from Texas, Mr. Hall, who will assume the chairmanship of the Space Subcommittee. He has been diligently attending the hearings, this one and the previous three hearings, to see how many mistakes I made so he could avoid them. He is going to be prepared to take over with a vigorous program in the near future.

Mr. Hall?

Mr. HALL. Mr. Chairman, thank you. I hate to start my tenure off by apologizing, but I do apologize to such a distinguished panel; to you, Admiral, Mr. Campbell, and Mr. Thompson for being late. My schedule showed that this started at 1:30. As my first act, I will get a more responsible person to handle the scheduling. I've been doing it myself. [Laughter.]

I know you cannot be specific on the new launch systems or the reconfiguration of the Space Station, but I want to ask a question or so. I wish we had more time.

We have had other panels here. We had a panel on the 29th of January and the 31st of January, not totally and completely complimentary of the past. I think the first panel did not seem to be very supportive of the NASA thrust, frankly, and I think you all will have an opportunity to read that and certainly will be given an opportunity to answer some of the things.

A Dr. Branscomb said only that he urged us to take the report seriously. Dr. Pike said that NASA had not even identified the problem. A Mr. Logdson said that we have been through 20 years of argument. It is easy, I know, to draw those summaries out of a 10 or 15 page speech, but that is what I gleaned from their testimony.

I am concerned about the cost and how we are going to raise the money to carry on the program that you want us to carry on, that you are recommending to us to carry on.

By the way, Mr. Chairman, may I have unanimous consent to send up an opening statement?

The CHAIRMAN. By all means, without objection, your opening statement will be inserted in the record.

[The prepared opening statement of Mr. Hall follows:]

OPENING STATEMENT

BY

RALPH M. HALL

I would like to commend the Full Committee Chairman on holding this hearing today. It is appropriate that we have begun our activities this Congress with a strong focus on the space program and NASA.

I look forward to serving as the Chairman of the Subcommittee on Space. I anticipate that we will face many challenges this Congress in reestablishing a healthy space program and a stable long term NASA budget. The Augustine report has given us some valuable recommendations in achieving these goals but they will not be easy to attain. Both the Congress and NASA will need to take a close look at the organizational issues confronting the space program. We will need to examine areas of overlap between NASA Centers, eliminate

overhead, and increase management efficiency. Not only does the taxpayer deserve this level of scrutiny, every dollar we put into the space program will be hard fought in this budget environment. We must make sure it goes as far as possible.

Since 1960, the space program has dominated our agenda in science and technology and was the defining force in the Global struggle for technological leadership. It is personally gratifying to me to be a part of continuing the high standards set by my long time friend from Texas Olin "Tiger" Teague, who chaired this Committee at the dawn of space exploration. Today we face much different challenges but our technological competitiveness remains as one of our highest national priorities. The space program will continue to play a vital role in this arena.

Once again, I want to thank you, Mr. Chairman, for holding this hearing and look forward to working with you and the Members of the Space Subcommittee.

Mr. HALL. Responsible staff has written it, and we will all read it together for the first time. [Laughter.]

The CHAIRMAN. We are going to enjoy the Space Subcommittee. [Laughter.]

Mr. HALL. Will Rogers said that he never tried to be funny—he just watched the government and reported the facts. [Laughter.]

WHAT IMPROVEMENTS WILL BE MADE IN THE MANAGEMENT AREA

In the hearings before this committee, the Augustine panel, when asked how they would recommend that we reduce NASA's budget, responded with eight specific recommendations.

Mr. Thompson, I am told that in a recent interview, you were quoted as estimating that the consolidating and streamlining of shuttle operations could eventually reduce costs by up to 25 percent. I think you may want to share some insights with us on that if I ever finish my question here.

They set out eight specific recommendations. I will not go through all eight of them but I will try to summarize them: no new starts; management changes; defer procurement of the fifth orbiter; redesign the Space Station; delay or delete funding for near-term demonstrations; reduce the duplication among centers; use present technology for the heavy lift launch vehicle—I know that Mr. Rohrabacher and others have all touched on some of these—and reduce the Mission to Planet Earth.

I know that you have plans to do many of them and others that we may have to do. I guess my question is to ask the panel what you are doing in the management area? Three major areas of complaint or suspicion were management, overhead, and overlap between the NASA Centers. I guess you are familiar with that.

I guess the real question is if you believe that NASA can address those. I think you should be given the first shot at addressing them on your own and certainly be given a chance to give these answers, but I think that the Congress is listening for some assurance that you are going to find some real cost savings in the management areas.

That is basically my first question, and that is a more important question than my second question. I will ask you just to comment on that, if you would.

Admiral TRULY. Let me comment briefly to the question: can we address the questions, with a resounding yes. As a matter of fact, we have already taken a number of actions based on the recommendations of the Augustine committee, one of which that you mentioned and asked about, in management.

One of the things we are going to be looking at is the roles of the centers and whether there is overlap. That is important enough that I have asked J.R. Thompson to lead that particular study during this year.

You also mentioned criticism that we have received and, certainly of all Federal agencies, we have. My only comment to that is that NASA is a very complex, very difficult agency to run. We have many programs. It is a lot easier to sit in your arm chair and criticize than to sit in the decision seat and run a very high risk program and keep it safe and deliver.

I do not think, however, sitting in their arm chairs and being just critical was the role of the Augustine report. I think they gave us some very specific and constructive ideas and we are moving out across the board to use them to help ourselves.

My only final comment would be that you touched on, early in your question, the most important part of all of this. That is: where is the money coming from and how is it going to be possible to meet the part of the Augustine report that is not talked about very much? That is: what are the resources required to have a robust space program? For that, we are going to have to do our best job to try to articulate why the program is one that the country should invest in in the future, but it is not within our ability, totally, to engender that support.

With the past support that we have gotten out of Presidents and Congresses, I am frankly optimistic this year that we can do the one thing that the President wants and I think the Augustine committee pointed out. That is, get some consensus and lower the decibels about goals and objectives and get some consensus between the Administration and Congress as to the direction we are heading, and then set about to try to provide those funds and ask us to do a good job in implementing.

The CHAIRMAN. Without objection, I am going to recognize Mr. Hall for his second question to see how short he can make it.

Mr. HALL. If you would, let me finish my first one. [Laughter.]

I think J.R. ought to be given the opportunity to comment on your ideas for bringing some savings out of this Space Shuttle program. Please be very brief with your answer.

Mr. THOMPSON. I believe that we can do a lot of things. Number one, in two months, we will have operated the shuttle for a decade.

I think now is a good time to stand back and look at the way we do business. We are spread out all over the country. I think there is a lot to be said for focusing a lot of the activity more at the launch site where we do the turnaround and the refurbishment. I think this is at work inside the program now.

We talk in the advance launch system of reducing the operating cost by an order of magnitude, a factor of 10. And that is a system that we do not know anything about.

As I indicated, we have been operating the shuttle now for a decade. We know a lot about it, and I think 20 to 25 percent is in the cards.

Mr. HALL. You were quoted correctly then.

Mr. THOMPSON. If we are going to really work toward having a new launch vehicle, we have to get smarter in the way we operate the one we know the most about. I think it is doable.

I know that NASA, I think, recognizes the charge. If we are really going to bring on line the new systems, we have to operate the old system smarter. I think there is room to do it and I think we have the right people working at it.

BIOMEDICAL RESEARCH

Mr. HALL. Thank you. Let me just very briefly hit my second question.

I am very interested in biomedical research on the Space Station. I think that Mr. Rose is going to give me some of his time sometime in the next couple of weeks or so to go into this. I think you are in charge of the commercial programs, are you not?

I think that to sell this program, we do need to bring the word frugality into it and we have some very attractive byproducts of your thrust in the commercial area. Simply, we have not found the cure for cancer here on Earth and we are going to find it somewhere.

That is something that everyone I talk to is interested in. That is: what are we going to find in space? What is the likelihood that we might find that elusive cure for cancer, heart disease, and diabetes?

We had a program several years ago. There was a lot of interest, including in the private sector, in producing pharmaceuticals and other medical breakthroughs in the low gravity of space. I just wonder: where is that program today and is there any significant private sector interest?

You would be surprised at the interest that we have right here on this committee and members of the families of members of this committee that have a personal interest in that. I do not suppose that there is a family across this country that would not be supportive.

I think that McDonnell-Douglas and Johnson & Johnson basically had done most of the commercial or private financing of it. I wonder where we are on that program?

Let me tell you right now, that is going to be probably one of my major thrusts as chairman, to try to give some leadership and impetus to that because we have AIDS bashes, and I am for finding a cure for AIDS, but frankly, more people die from cancer, heart, and diabetes in the first six days of the year than they do all year from AIDS. And we know how we get AIDS and we do not know how we get any of the others.

I just wonder where we are on this program and why it is that we cannot get it underway.

Admiral TRULY. That particular effort that you mentioned is one that has now, I believe, gone by the wayside. It turned out that on one of my shuttle flights, I flew that particular electrophoresis experiment.

Mr. HALL. And you had some discouraging aftermath of it, did you not?

Admiral TRULY. I would have to leave it to the companies as to what the economics were as to why they did not continue that particular effort, but one principal effect was, after the Challenger accident, when we had a long hiatus in space flight to do that sort of research. However, frankly, the promise of micro-gravity research and life sciences research which are the two primary purposes of the Space Station, the promise, I think, is there for a discovery that we cannot predict.

I think it would be very unwise of me to try to predict such a thing. Frankly, most of the things, the most valuable things that we get out of research are serendipitous. We did not precisely see where the technology or research was going to lead.

Specifically within NASA, we are investing heavily in both the life sciences and the commercial programs which shows where some of our priorities are.

Mrs. Morella. Would the gentleman yield?

Are you working with the National Institutes of Health? It seemed to me that on one of my visits there, they showed me what was being done with regard to calcium in the limbs and whatever, which was a direct result of what was happening on our space missions.

Admiral Truly. I might ask Dr. Fisk who is AA for Space Sciences and Applications to make whatever comment he would like.

Dr. Fisk. The answer to the specific question is, yes, we are working with the NIH and we do have a memorandum of understanding with them on cooperative research activities. They are interested in our facilities on SpaceLab and, ultimately, Space Station, and we are interested in their ground-based facilities. I think it will be a very cooperative program.

Mrs. Morella. So then what we have to do to carry on with Congressman Hall's question is to try to elicit the interest of the private sector?

Dr. Fisk. There are some very basic research activities that are being conducted which are directly related to your question. When you do protein crystal growth in space, one of the reasons for that is to design better drugs for a number of medical applications including cancer research.

Mr. Hall. Well, I will tell you what I was told. Was John Fabian on that flight?

Admiral Truly. No, John was not on my flight although I think he flew the CFIS experiment on another flight. I never flew with John.

Mr. Hall. I am not sure who told me this, but I understood that they did pursue that process and that they did bring back either pharmaceuticals or crystals or whatever and that bacteria had attacked them before they could get them to the lab, and then it just has not been picked up since that time.

I do not expect anybody to answer that. That is just something that I have heard. I just want to impress upon you that there are a lot of members of this committee and this Congress and this nation that are interested in pursuing the cure to these very dreaded diseases, and if we have not been that successful in finding them here on earth, maybe we will find them somewhere else.

Thank you very much, Mr. Chairman.

The Chairman. Thank you very much, Mr. Hall.

Mr. Hall is absolutely correct. If you could come back with a spectacular like that from space, your budget would not have to be worried about for awhile.

Mr. Bacchus, glad to have you back.

NASA Reaction to Recommendation Consolidating Space Shuttle Operations at KSC

Mr. Bacchus. Thank you, Mr. Chairman.

Admiral Truly, I am the new member representing Central Florida. I succeeded Bill Nelson here, so you will not be surprised that I

am interested in the future of the Kennedy Space Center in our district.

I also want to say that I am inclined to be very supportive of the President's budget overall and will work hard to obtain a generous increase for NASA. In fact, I would like to see even greater increases.

My question is this: the Augustine report recommends consolidating the Space Shuttle operations at the Kennedy Space Center. How is NASA interpreting that recommendation and how is that recommendation reflected in the proposed budget? Specifically, I would appreciate it if you would comment on how the recommendation might apply to astronaut training, to mission control, and also to shuttle landings.

Admiral TRULY. First of all, the direction that I have given to Dr. Lenoir who runs the shuttle program and in turn to Bob Crippen who is the program director, because of the criticality of crew safety and the effect of shuttle organization and program management to the safety of the operation, to be very, very cautious as they go through analyses of how we might implement that recommendation over time.

In addition, however, I have asked them to take over the next several months the action to look at what could be done to move in that direction. As to the three things that you specifically asked about, frankly, I think that the cost of moving in-place mission control centers, astronaut training facilities, large mainframe computer systems, and simulators is not the direction that we would be going in.

We have already made significant moves with regard to improving the logistic support and focusing that at the Cape. I think that in the area of sustaining engineering there are some opportunities to make progress in doing that, but frankly, what I have done is to ask Lenoir and Crippen to study that very carefully and come up with recommendations.

As far as landing shuttles at the Cape, under the right conditions, which are safety rules and protection of the systems, we have demonstrated that we are quite willing to land at the Cape under those conditions. We did divert from Edwards to the Cape two or three flights ago and that worked fine, but that was a very unusual weather situation where the weather out at Edwards uncharacteristically was very bad and the weather at KSC was uncharacteristically—the weather down there quite a bit of the time is very good, but it is unpredictable.

On this particular day, it was a weather condition that was very, very stable. Therefore, we could predict prior to the de-orbit burn that it would remain that way through the landing.

Mr. BACCHUS. I certainly share your concern about safety and applaud that concern. We did, as you mentioned, have a safe landing recently. I am mindful of the weather and other considerations.

Are there any braking or other technical innovations that might be in the offing that might lead to more shuttle landings and more possibility for shuttle landings at the Kennedy Space Center?

Admiral TRULY. We have made a number of investments in the vehicle including braking and nose-wheel steering and so forth that makes us confident that, under the proper conditions, we are will-

ing to go there. However, with the investment in our infrastructure of turnaround capability at Edwards and the availability now, thanks to the support of this committee and the Congress to getting a second 747 carrier aircraft, and at flight rates building up to 10 per year in the next few years, we believe that we still have a margin to continue landing at Edwards and transporting the vehicles to the Cape. So, I think at least in the near-term, that we will continue to see that type of an operation.

Mr. BACCHUS. Thank you very much, Admiral. Let me say again that I intend to work very hard to get a substantial increase for NASA.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Next is Mr. Kopetski.

NASA AND THE DEFICIT

Mr. KOPETSKI. Thank you, Mr. Chairman.

Admiral Truly, I am new here as well. I come from the other end of the continent from my good friend from Florida, out in Oregon.

I am still trying to figure out if anybody in this town cares about the Federal deficit because it keeps getting larger, and we in Oregon do not have a space center, but we all have to pay taxes. You folks get—the way I look at it, my math—about 25 percent of all the domestic spending increase that we can do in this Congress, about $2 billion out of the $8 billion that is there under the budget agreement for last time.

We see the recession is getting deeper and see Desert Storm that we have to foot the bill for, and I am curious to know if anybody in the White House or OMB or the Vice President has come to you in the last few weeks or month and said: we have more people hurting out there, or: the deficit is worse, or: we have to pay for Desert Storm and we would like you to cut back a little bit on your budget so that we can fund some of these other activities or just not spend the money at all, i.e., keep the budget deficit down.

Admiral TRULY. I have had extensive discussions about my budget with the White House and I can assure you that the robust and strong support of the President in my budget request of $15.7 billion is not what I asked for originally, and we have had extensive discussions about the priority of investing in programs like the space program that does help the future economic competitiveness of the country relative to these very problems of the deficit. It is their opinion and mine that it continues to be a good investment.

Mr. KOPETSKI. But short-term, whether for funding Desert Storm—nobody has talked to you about it in that context?

Admiral TRULY. The Desert Storm operation, no. The President has built his budget totally understanding the situation there and has not come to NASA in order to reduce the budget that he just submitted to the Congress.

Mr. KOPETSKI. I assume that you would not recommend to this committee that we cut your budget to help fund Desert Storm or reduce the deficit.

Admiral TRULY. I believe that NASA's contribution to the technologies that are being demonstrated in the Desert Storm oper-

ation reflect the wisdom of investing in technology and research. To cut our budget for something as specific as that would deprive the Nation of the future benefits of that research and investment and, today, would be very unwise.

EARTH OBSERVING SYSTEM

Mr. KOPETSKI. Admiral, for you to understand, I do not think we could make a smarter investment in this country than to invest in educating kids on math and science programs, but the reality is a war. Reality is the deficit.

Let me ask you, in terms of what you are proposing in your budget about the EOS system, if you folks intend to fly any earth observation sensors directed towards commercial and governmental operation applications.

Admiral TRULY. One of the recommendations of the Augustine report was that we go back to a different funding arrangement with NOAA in that NASA returned to where we do pick up the funding responsibility for research and development instruments that could be applied later to commercial or earth-viewing systems. We have accepted that recommendation and are discussing with NOAA the details of what that would mean.

I believe that there are instruments that are going to be funded in the EOS program that, in future years, will be directly available to an earth-looking system. So I think there is a direct connection there, but that connection is years in the future, which is the nature of early research.

Mr. KOPETSKI. Is there anything that you folks intend to do then to encourage this commercial use of EOS information?

Admiral TRULY. If I may, I would like to get Len to comment on that.

Dr. FISK. The data on EOS which will be quite comprehensive and will include some very high resolution data as well will be made generally available to everyone including researchers, and we will follow and very carefully follow the applicable laws on making this data available to the commercial sector. As you know, there are a number of laws on the books which say that you take this data, make it available en masse, and then it is distributed commercially. It is our intention both to follow that and to encourage that.

We also are funding a particular institute called Ciesin, which is located in Michigan, that has as one of its purposes to make the data that will be available throughout the Mission to Planet Earth program readily available for applications. They are being funded to develop the interface between ourselves and the commercial and applications activities.

Mr. KOPETSKI. Thank you very much.

Thank you, Mr. Chair.

The CHAIRMAN. Thank you, Mr. Kopetski. One of the areas of longest interest on my part is the Landsat Earth Observing System and the commercial values it can promote, both commercial and scientific. It is sort of at a crossroads in its existence. It either has to get better or it has to be killed, and we have to decide how to go

about doing that and you might be quite interested in how we can do that.

Mr. KOPETSKI. Absolutely.

The CHAIRMAN. Mr. Cramer.

CONSTRUCTION OF FACILITIES FUNDING

Mr. CRAMER. Thank you, Mr. Chairman.

Admiral Truly, J.R., Mr. Campbell, welcome here, and I appreciate your being here. As you know, I am a new member as well and I cross the continent between Mr. Bacchus and Mr. Kopetski here. I am from Huntsville. J.R. was recently one of our products down there, and we congratulate you on the role that you are now playing here as well.

I grew up almost as a product of the NASA program there in Huntsville, so I know what its potential has been and I know that lately it has gone through some difficult times. I, along with my colleague Glen Browder, also share a very positive attitude about NASA, and I am here to try to help NASA regain its position in the space program as well.

I have looked at your budget and I now specifically want to ask you about a couple parts of the budget. One is about the construction of facilities part of the budget.

Do you think that side of your budget is adequate? Do you think it meets the needs? Are we playing catch-up there? Are there deficiencies that this particular budget does not address that you would like to make this committee aware of?

Admiral TRULY. I think I would say yes to two parts of your question. We are playing catch-up in part of our C of F budget because we find ourselves needing to invest strongly in the maintenance and refurbishment of a number of our facilities. We have made a strong argument to the Congress in the past couple of years, and we have been supported. There is a part of this initiative in the C of F budget that we need.

However, as far as new facilities go and in general, I think that this budget does adequately represent the needs of the agency for fiscal year 1992, but I think you will see in coming years a continuing emphasis on our part to keep up this national investment.

Mr. CRAMER. With regard to your budget, the Advanced Solid Rocket Motor Assembly program over in the northwestern corner of Mississippi, which has a positive impact on the 5th District of Alabama as well, is that part of the construction part of the budget? Is that pretty much an indication that that project is on line and still viable?

Admiral TRULY. I might see if J.R. would have a comment, but yes, the project is started. We are getting underway and plan to keep it moving forward.

J.R., do you want to add to that?

Mr. THOMPSON. Well, I just would add that it is very much, I think, at the heart of our transportation system. We are very much counting on its capability to lift the station and to help us assemble it in bigger pieces as well as the reliability. It has gone through a lot of discussion as you well know.

We are spending several hundreds of millions this current year, and it is on a solid track now, I think, being very solid in the program. There is a big job down there that has to be done and I think the Washington side—we have done our thing, and now we need to get that facility built and get that development program well along within the schedule that we are counting on as well as the cost.

The message to carry back is: yes, I think that solid rocket motor is in place. Now we have got to do it.

Mr. CRAMER. Okay.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Mr. Cramer.

Mr. Nagle.

Mr. NAGLE. Thank you, Mr. Chairman.

Admiral Truly, I would like to do something I do not normally do. I would like to congratulate you.

Admiral TRULY. Thank you, Mr. Nagle.

Mr. NAGLE. Don't get excited because there is more. [Laughter.]

That is, your efforts on something that has been of great interest to this committee in recent years, the practice of using the Space Shuttle to launch payloads that could otherwise be carried by an expendable rocket without causing any risk to the crew. As you know, in each of the past two years, this committee had passed language that would restrict this past practice.

We have carefully reviewed the new Space Shuttle launch manifest that you released earlier this week, and we have noticed that beginning in 1994 you have removed all of the remaining communication satellites that had been planned for the shuttle launches in earlier versions of the manifests. I just wanted to add that we appreciate your efforts in this action.

As a footnote, however, I might note that there appears to be some hesitancy in some parts of NASA to move the 1998 launch of the AXAF to an expendable vehicle. I would only note that we will be watching these developments with interest.

Nevertheless, it appears to me that you are moving in the right direction, and rare as it may be, I wanted to take a moment to congratulate you on your direction.

Nice try, Mr. Chairman.

The CHAIRMAN. We appreciate your contribution, Mr. Nagle. Now——

[Laughter.]

Mr. NAGLE. I get five minutes and I am going to use every second of it, boss.

Roe was such a kind and generous man. [Laughter.]

Nelson was enlightened. [Laughter.]

STATUS OF NATIONAL RESEARCH COUNCIL REPORTS

Admiral Truly, the NASA authorization bill that was passed by Congress last year contains the requirement that you direct the National Research Council to conduct two studies. First is an assessment of the quality assurance and testing program that we use to ensure the safety and the quality of the Advanced Solid Rocket Motor. Second is an assessment of the requirements, benefits, and technological feasibility of earth to orbit propulsion system options

that could be developed to support the assembly and operation of the Space Station and in other potential space activities beyond the year 2000.

The legislation requires both studies to be completed and submitted to the Congress by July 1, 1991. By the way as a further background, we have been told by the National Research Council that each of these studies would require a minimum of six months to complete.

Could you please tell us the current status of these reports that are now due to us in a little over three and a half months?

Admiral TRULY. We have been dealing with the National Research Council and we have been delayed. I might ask Dr. Lenoir to add anything he might like to say to this.

We have been delayed, as I understand it, in kicking off the ASRM cost and schedule study, so we may have to come to the committee and ask for an extension, but it is our full intent to conduct such a study. I think we need to do so.

If I might, I will ask Bill to add a comment to that.

Dr. LENOIR. Yes, we have been delayed in getting started with respect to the ASRM primarily due to a slowdown in getting the contractor and the subcontractors on board and under contract and getting that activity off and running as we felt we should before we kicked off this activity.

We do have, or I should say that I do have the letter ready—it has been through our review—that I am about to send over to Admiral Truly asking him to sign it, officially requesting that the NRC kick off this activity. And you are right; the time that will be required will take longer and we will have to come in for an extension.

Mr. NAGLE. Admiral or Dr. Lenoir, just as recently as this morning, I checked with the National Research Council to determine the status of the two studies. I learned as a result of that inquiry that it was not until two weeks ago that representatives of your agency made the initial contact with the NRC concerning the first of the two studies.

The NRC was told by NASA that it would receive a letter within a couple of weeks directing it to begin the first study. As of this morning, the letter had not yet been received.

Dr. LENOIR. That is correct. We have not mailed the letter. Perhaps the misunderstanding—and I am not sure what is behind it—but the disagreement as to when we had begun talking with them may be specifically tied to this particular letter. I know that we have had discussions with them far more than two weeks ago dealing with this very issue and, among other things, investigating the availability of Dr. Stever, who apparently will not be available to do this activity. But it has been some time that we have been discussing this activity with them.

Mr. NAGLE. I was told by representatives of the agency as recently as two weeks ago that the initial contact was only made regarding the first of these two studies. I either misunderstood or was informed in error, or they are somehow mistaken.

Dr. LENOIR. We will have to research that and find out exactly who did what to whom here and put together the chronology.

[This information follows:]

NASA
National Aeronautics and
Space Administration
Washington, D C
20546
Office of the Administrator

MAR 6 199

The Honorable George E. Brown, Jr.
Chairman
Committee on Science,
Space and Technology
House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

Section 111 of the FY 1991 NASA Authorization Act contains four reporting requirements related to the Advanced Solid Rocket Motor (ASRM) program. Following is a restatement of each direction included in Section 111, along with an explanation of the status of our progress to date in fulfilling each requirement.

"(1) A report on the projected cost to complete the design, development, and qualification of the Advanced Solid Rocket Motor. The first report shall be submitted by March 1, 1991, and thereafter with the National Aeronautics and Space Administration's annual budget request."

In order to eliminate duplicative reporting, I am enclosing NASA's latest Project Status Report (PSR) on the ASRM, normally transmitted on March 15, to fulfill this requirement.

Following a January 1990 recommendation by the General Accounting Office (GAO) that NASA submit PSR's to Congress on a variety of research and development programs, including the ASRM, the Agency has formulated and transmitted such reports to the Committee twice yearly, on March 15 and July 15. The PSR's address the development cost, schedule, and progress toward achievement of the project's technical objectives. The ASRM PSR contains, among other data, the projected cost to complete the design, development, and qualification of the ASRM.

"(2) An annual report on the projected unit cost of the flight motors."

We propose to submit the initial unit cost report on October 1, 1991. This schedule will allow us to reflect input from the full budget preparation process and the Program Operation Plan (POP) process. Future reports will be incorporated in biannual PSR submittals.

"(3) An annual report on the increase in Space Shuttle payload capability provided by the Advanced Solid Rocket Motor. The report shall include the original baseline payload capability, adjustments to that baseline capability, and the projected payload capability."

Our initial estimate of the increase in performance to be provided by the ASRM is 12,000 pounds. We propose that performance information be henceforth incorporated in biannual PSR submittals.

"(4) An assessment by the National Research Council by July 1, 1991, of the quality assurance and testing program that will ensure the achievement of safety and reliability for the Advanced Solid Rocket Motor."

The National Research Council (NRC) has been formally requested by NASA to review the quality and testing plan of the ASRM. The NRC has agreed to conduct this review and has indicated that, while it can prepare a "letter status" report by July 1, 1991, a final report cannot be submitted until September 1, 1991. Therefore, we believe we can meet the direction for an NRC assessment with the NRC letter report; nevertheless, we request an extension of the due date for the final NRC report to September 1, 1991.

During the coming year, we will work closely with the Committee to keep it informed on matters relating to the ASRM and to meet the dates outlined above. NASA has made substantial progress during the last year on the ASRM program. The ASRM continues to play an important role in planning for the future safety and performance of the Space Shuttle and is intended to be a key element of a new National Launch System.

I trust you will not be averse to accepting the proposed use of the PSR as the future basis of our ASRM reporting requirements to the Committee in order to minimize duplicative reporting and to provide the Committee with a continuing, comprehensive assessment of this program.

Sincerely,

Richard H. Truly
Administrator

Enclosure

cc:
The Honorable Robert Walker

Project Name: Advanced Solid Rocket Motor (ASRM)

PROJECT STATUS REPORT

Submission Date: MARCH, 1991

Table of Contents		Page
Part I	Project Status	1
Part II	Project Cost Estimates	2
Part III	Funding for Project Development	3
Part IV	Principal Milestones	3
Part V	Project Goals and Objectives	4
Part VI	Project Background	5

PART I -- PROJECT STATUS

In April, 1989, NASA chose Lockheed Missile and Space Company (LMSC) as the prime contractor for development, design, test, and evaluation (DDT&E) of the Advanced Solid Rocket Motor (ASRM). Major subcontractors are Aerojet - ASRM Division for motor design and Rust International for facility design and construction. The new motor will increase safety and reliability, and will provide an additional 12,000 lbs. of payload capability. The motor design consists of three segments - bolted field joints and welded factory joints. Technical considerations have led to use of an ablative versus the carbon-carbon integrated throat entrance nozzle. An interim contract to initiate work on the ASRM was signed in August, 1989. The DDT&E contract was signed on May 11, 1990, and the facilities contract was signed on May 25, 1990.

The production facility for the manufacturing of the ASRM will be located at the Yellow Creek Facility in Iuka, Mississippi. Site work preparation began in August 1990. Static testing of the motor will be accomplished at the Stennis Space Center (SSC) in Bay Saint Louis, Mississippi; nozzle manufacturing will be at the Michoud Assembly Facility (MAF) in New Orleans, Louisiana; subscale motor testing will take place at the Marshall Space Flight Center (MSFC) in Huntsville, Alabama. A significant amount of activity has been underway since the signing of the ASRM prime contract in May 1990. All major subcontracts are under letter agreements and plans are to have definitized contracts by August of this year. Ground clearing is underway at IUKA, Mississippi and critical Air and Wetlands permits have been approved for Yellowcreek and Stennis, respectively, which will allow facility construction to begin in the Spring.

Facility design specifications overall are 32% complete, somewhat behind plan. The primary driver for facilities being behind schedule has been the lack of plant equipment specifications needed for facility design. The delay in plant equipment specifications was due to cost mitigation reviews conducted to minimize plant equipment costs. This activity has recently been completed and the pace of equipment and facility procurement awards has increased markedly.

In addition, revised schedule and cost plans for the total ASRM program are being formulated. This process has been underway for several months and will provide a comprehensive reevaluation of the total effort required to accomplish the program objectives. This reassessment should be complete within the next 45 days, i.e., by mid-April.

PART II -- PROJECT COST ESTIMATES
(Real-Year Dollars in Thousands)

COST COMPONENTS	INITIAL PROJECT ESTIMATE	DEVELOPMENT ESTIMATE	LAST PSR ESTIMATE	THIS PSR ESTIMATE	AMOUNT OF AND REASON FOR CHANGE
PRIMARY NASA PROGRAM OFFICE OFFICE NAME OSF	*1,979,000	N/A	---	2,100,000- 2,200,000	Funding reflects FY91 Congressional Budget estimates. Revised cost estimates should be completed by mid-April.
SUPPORTING NASA PROGRAM OFFICES	**200,000	N/A	---	450,000	Plant equipment added to CofF in FY 92.
NASA SUBTOTAL	2,179,000	N/A	---	2,550,000- 2,650,000	
OTHER U.S. AGENCIES		N/A	N/A	N/A	
OTHER U.S. PARTICIPANTS		N/A	N/A	N/A	
NON-NASA SUBTOTAL	0	N/A	N/A	N/A	
TOTAL	2,179,000	N/A	---	2,550,000- 2,650,000	Funding reflects FY91 Congressional Budget estimates. Revised cost estimates should be completed by mid-April.

*Initial project estimate has been adjusted to assure comparability; the estimate now includes $510 million for the first six flight sets of hardware. This hardware was included in the development phase of the negotiated contract.

**Brick and mortar facilities requirements originally in SFCDC budget.

***Estimates were under review pending completion of post-contract-definitization reviews.

Development estimate will be established at PDR.

PART III -- FUNDING FOR PROJECT DEVELOPMENT
(Real-Year Dollars in Thousands)

	PRIOR YEARS	FY 89	FY 90	CURRENT FY 91	FY 92 REQUEST	FY 93	BALANCE TO COMPLETE	CURRENT PROJECT DEVELOPMENT COST ESTIMATE
PROJECT DEVELOPMENT FUNDING	(20,800)**	51,000	160,400	309,100	200,000	339,400*	1,040,100-1,140,100 *	2,100,000-2,200,000 *

*Estimates reflect the FY 1991 Congressional Budget plan, adjusted for the FY 1992 budget request. A revised program development phasing is now in preparation.

**Phase B effort not included in EAC.

PART IV -- PRINCIPAL MILESTONES
(Calendar Year and Month)

MILESTONES	INITIAL PROJECT ESTIMATE	DEVELOPMENT ESTIMATE	LAST PSR	THIS PSR/ ACTUAL*	REASON FOR CHANGE
REQUEST FOR PROPOSALS	6/88	N/A	8/88	8/88	
DEFINITION CONTRACTS AWARDED	2/89	N/A	4/89	4/89	
ALL PRELIMINARY DESIGN REVIEWS COMPLETED	8/89	N/A	TBD	2/92	
ALL CRITICAL DESIGN REVIEWS COMPLETED	8/91	N/A	TBD	TBD	Dependent on FY 1992 budget decisions.
LAUNCH DATE (first flight)	4Q/94	N/A	TBD	TBD	Dependent on FY 1992 budget decisions.
PROJECT COMPLETION	4Q/95	N/A	TBD	TBD	Dependent on FY 1992 budget decisions.

**Development estimate will be determined at PDR.

PART V – PROJECT GOALS AND OBJECTIVES

	PROJECT GOALS	SCIENCE/TECHNICAL OBJECTIVES
INITIAL PROJECT PRESENTATION TO CONGRESS	Enhance Shuttle system safety, reliability and performance	-Improved Flight and Safety Design Margins - Mechanical and ballistic redesign -Producibility changes -Industrial safety and environmental safety -Payload Capability goal - 12,000 lbs
DEVELOPMENT ESTIMATE	N/A **	
LAST PSR	No change from initial project presentation	No change from initial project presentation
THIS PSR	No change from initial project presentation	No change from initial project presentation Projected Increased Payload Capability - 12,000 lbs. thru Preliminary Design based on the current Trajectory Design Data Package, which includes ASRM thrust shaping, 104% SSME, 28.45 degrees inclination and 690 PSF dynamic pressure limit
REASON FOR CHANGE	N/A	
FINAL PERFORMANCE STATEMENT	N/A	

**Development estimate will be established at PDR.

PART VI -- PROJECT BACKGROUND

PROJECT'S RELATIONSHIP TO NASA'S STRATEGIC PLAN

The ASRM contributes to the agency goal of attaining a safe, sustainable shuttle flight rate, completing the development of the Space Shuttle System, reducing operational costs, and exploiting the Space Shuttle inherent capabilities.
The ASRM development is critical to NASA and will provide substantive improvements in flight safety design margins and reliability, achieve full shuttle payload capability, optimize program cost and promote industry competition.

GENERAL BACKGROUND

1984-SRM 2nd source assessment
1985 -SRM Block II studies
1985-Decision to proceed with SRM 2nd source competition with contractor investment
1986-Challenger accident
1987-SRM Acquisition strategy and plan to Congress
FY87-NASA Appropriations act with funds for Phase B studies
FY87-NASA Authorization Act (H.R. 5495) requiring ASRM RFP or SRM recompetition or 2nd source
1988-NASA/OMB reviews and program decision
1988-SRM Acquisition plan to Congress with ASRM decision
FY89-Appropriation Act for ASRM New Start (project approval) selected contractor
FY90-Contract awarded

PRIMARY NASA COMPONENTS AND THEIR RESPONSIBILITIES

Overall program responsibility
Office of Space Flight - Space Shuttle Program
Project Management
Marshall Space Flight Center - ASRM Project

PRIME CONTRACTORS AND THEIR RESPONSIBILITIES

Lockheed - Project Management; SE&I, support equipment; safety, maintainability and quality assurance; facilities management
Aerojet - Engineering, manufacturing; quality assurance, testing
Rust - Architecture and engineering; construction
Babcox and Wilcox - Case manufacturing
Thiokol - Nozzle design and manufacturing

OTHER PARTICIPANTS AND THEIR RESPONSIBILITIES

Mr. NAGLE. I was told by the NRC that NASA has not yet even made the initial contact with regard to the second study.

Dr. LENOIR. The second study—it appears with the Space Station restructuring, among other things going on, that it does not make sense to initiate that activity until the Space Station itself has settled down and we know where it is headed. So we have decided, until the Space Station restructuring is reported out, accepted, and we have the Space Station on firm footing—so that it makes sense to look into that time frame in the late nineties.

Mr. NAGLE. I would like to suggest to you, if I may, that I do not believe that we gave NASA the option in the law of determining whether or not and when they would seek those studies. The requirement of the studies should have been no surprise to NASA.

The bill containing the language passed the subcommittee last March on the 13th day and passed the full committee and the House of Representatives in September. The final conference report passed the House and the Senate in October, on the 25th on the House side.

The bill was signed into law by the President on the 16th of November. Now I gather from reading the Admiral's testimony, that had I not raised these questions about the status of these studies, we never would have been told that the mandate of this committee and the Congress, NASA had elected to ignore. If that is the way we are going to work, then I think the committee needs to know that when we pass something and the President signs it, you are free to consider a second option and maybe get back to us if we happen to remember it.

Admiral TRULY. Let me state both for the record and, Mr. Nagle, so you will understand: NASA does not intend to unilaterally ignore anything in the laws that pass that are requests from this committee. However, in those same months, we also did get a $6 billion decrease in the Space Station program which put the entire program into a large restructuring exercise. We were delayed in getting the ASRM program contracts negotiated, so I believe that the delays in the study have represented changes that have happened since then and not any indication that we do not intend to comply.

Mr. NAGLE. Would it not be a better practice—Mr. Chairman, if I could just pursue this briefly—would it not be a better practice, if you are not going to do a study that is mandated by law, that you notify us in advance of the expiration date of that study that you are not going to do it or that circumstances have arisen that do not permit you to do it? I mean, would it not be better to do it that way than to wait until the last minute?

[The information follows:]

NASA

National Aeronautics and
Space Administration

Washington D C
20546

Office of the Administrator

March 6, 1991

The Honorable George E. Brown, Jr.
Chairman
Committee on Science, Space and
Technology
House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

At the Committee's February 7, 1991, NASA budget overview hearing, a Committee member, Congressman David Nagle, contended that NASA was not being responsive to Congressional guidance contained in the FY 1991 NASA Authorization Bill (P.L. 100-681) concerning National Research Council (NRC) assessments of the Advanced Solid Rocket Motor (ASRM) program and Earth-to-Orbit propulsion systems and, further, that questions for the record were still outstanding for last year's Fisher-Price hearing on March 29, 1990. I wish to set the record straight on these matters and to highlight to you the continuing emphasis within NASA to respond forthrightly to the Congress.

ASRM Review by NRC. To initiate implementation of Section 111(4) of P.L. 100-681, and in order to comply with the Committee's requested timing, NASA began discussions with the NRC in November 1990 to review the quality and testing plan of the ASRM. The NRC has agreed to conduct this review and has indicated that, while it can prepare a "letter status" report by July 1, 1991, a final report cannot be submitted until September 1, 1991. Therefore, we believe we can meet the direction for an NRC assessment with the NRC letter report; nevertheless, we request an extension of the due date for the final NRC report to September 1, 1991.

Earth-to-Orbit Propulsion Systems Review by NRC. Section 125 of P.L. 100-681 required an NRC assessment of Earth-to-Orbit propulsion system options. NASA is currently formulating a statement of work with NRC to form an independent panel of recognized experts to accomplish this assessment. Unfortunately, this effort will not be completed by July 1, as required by the Act, and an extension of several months will be requested.

One reason we are behind on this initiative is the fact that the key players involved with tasking this study are involved in an ongoing DOD/NASA review of a new national launch system. This review is focusing on propulsion system options and should act as a good baseline for the NRC review. The preliminary results of this review will be completed soon, and I would be glad to discuss them with the Committee as soon as they are available.

Fisher-Price Hearing. We have researched NASA's records and can find no outstanding questions for the record from the Fisher-Price hearing, and I understand this has been confirmed by your staff. NASA is still formulating an On-Orbit Operation and Maintenance Servicing Plan that was discussed at the March 29, 1990, hearing, and NASA has informed the Committee this will not be available until June 1, 1991, due to the Space Station Freedom restructuring exercise. I should note there is an additional outstanding action concerning maintenance and IVA requirements during assembly from a September 27, 1991, Subcommittee hearing. This issue is currently being addressed by the Space Station Office and will be routed to the Committee as soon as possible.

I hope that this background information and current status is helpful; you can be assured of my continued emphasis on excellent relations with the Committee. NASA intends to continue to work closely with you to formulate a consensus on the goals and objectives of the civil space program and to get the FY 1992 budget approved.

Sincerely,

Richard H. Truly
Administrator

cc:
The Honorable David R. Nagle

Admiral TRULY. I certainly am embarrassed to find out if we have not been dealing with the committee. That is one of the things, about a year ago or at least a year and a half ago when J.R. and I took over NASA, that we were criticized for. Through our Office of Legislative Affairs, we have made a major effort to make sure that we do meet our commitments. We will take the action to go and see what the facts are about this one and get back with you.

Mr. NAGLE. The only other question I have, which I will be happy to submit in writing, is that in the hearing with Dr. Price and Dr. Fisher, certain material was promised to be furnished to this committee, and I noticed this morning in reviewing their testimony that we had not received it. I will submit that to you in writing.

I do think it would be better practice if you have a mandate from the committee to give us information that you either on your own tell us you are not going to give, or supply it, one of the two. I think there ought to be a test in here that if we can remember it, you are going to bring it. If we forget it, you can get by without it.

Admiral TRULY. I certainly accept that comment and will review what we have promised the committee and what the circumstances are.

Let me also say on your previous comment—and I appreciate your commendation on our manifest. If our manifest went out to 1998, you would find AXAF on an ELV.

Mr. NAGLE. On what?

Admiral TRULY. On an expendable launch vehicle.

Mr. NAGLE. Then I am glad to hear that, and I applaud you for that effort. Thank you.

The CHAIRMAN. Have we missed any members who desire to ask questions?

[No response.]

The CHAIRMAN. Let me ask just one question myself, Admiral Truly, and this is just for clarification.

In talking about the proposed new launch system, how broadly do you define the term "system"? In other words, does it extend beyond the vehicles—we gather that we are talking about a range of vehicles of varying capacity—to reconfiguring launch capability, range capability, and other aspects related to the total problem of getting man and cargo into space?

Admiral TRULY. The answer, Mr. Chairman, is a very simple yes. It goes all the way to the infrastructure, the facilities. It includes upper stages where needed to meet the DOD requirements. It includes a smart front end to be able to get the payload of this new system to the Space Station to help in the logistics and servicing.

I think it is a comprehensive end to end look. Now the big issue is the affordability, which we will be discussing with this committee during this year. I believe it is a very comprehensive look going from A to Z.

The CHAIRMAN. That is what I wanted to get on the record because there is a tendency on the part of some, and it includes some senior members, to think just in terms of a vehicle, a heavy lift vehicle or something like that.

Admiral TRULY. This is much broader than that.

The CHAIRMAN. That is what I understood, and I wanted to make sure that was clarified.

I want to express my appreciation to all of you for your patience and for the responsiveness of your answers.

Mr. NAGLE. Mr. Chairman, aren't we going to go around again? [Laughter.]

The CHAIRMAN. This is what happens when a member comes in two hours late, only gets five minutes, and now he wants to have another round. The answer is, no, we are not going to have another round.

Mr. NAGLE. Then I assume I would have leave of the Chair to submit some additional questions beyond the few questions I was able to ask; right?

The CHAIRMAN. You not only have permission; you are invited to do so, and I think that Admiral Truly will be more than happy to respond to other questions from members and from the staff.

Mr. Nagle really is a nice guy, but——

[Laughter.]

The CHAIRMAN. Thank you again very much. We appreciate your being here. Thanks to all of your associates, and we will look forward to further hearings on these issues.

The committee will be adjourned.

[Whereupon, at 3:40 p.m., the committee was adjourned, to reconvene at the call of the Chair.]

1992 NASA AUTHORIZATION

THURSDAY, FEBRUARY 28, 1991

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON SPACE,
Washington, DC.

The subcommittee met, pursuant to notice, at 9:38 a.m., in room 2325, Rayburn House Office Building, Hon. Ralph M. Hall (chairman of the subcommittee) presiding.

Mr. HALL. Good morning. I want to welcome all of you, of course, to the Space Subcommittee's first hearing on the NASA authorization request for fiscal year 1992. I, along with many others on this committee, consider ourselves supporters of a strong, vital civil Space Program. We also are all believers in making sure that the Nation gets its maximum return on our investment in space, whether that return is measured in knowledge, increased competitiveness, or benefits to society in general. So we're all headed in the same direction.

This may from time to time appear to require that we hold NASA's feet to the fire, and I won't shy away from that, but it also means that the subcommittee intends to build on the work that you have done and that you have preserved and that you are preparing and on the work that the Augustine Committee has set forth and to join with the rest of the Congress, with the Administration, and our international friends, where appropriate, to craft a civil Space Program that can carry us on into the 21st century.

NASA has some major new programs under way and under development, and we need to know more about those programs. We also need to know what the prospects for science will be on the restructured space station and many other things. I realize that we won't get to know those as long as members of Congress are talking, that we need to hear from those very distinguished guests we've invited, and with that, I'll recognize the ranking Republican, Mr. Sensenbrenner, for his remarks.

[The prepared opening statement of Mr. Hall follows:]

OPENING STATEMENT

by

Ralph M. Hall

NASA Authorization Hearing
February 28, 1991

GOOD MORNING. I'D LIKE TO WELCOME ALL OF YOU TO THE SPACE SUBCOMMITTEE'S FIRST HEARING ON THE NASA AUTHORIZATION REQUEST FOR FY 1992. IT IS ALSO MY FIRST HEARING AS CHAIRMAN OF THE SUBCOMMITTEE, AND I'M LOOKING FORWARD TO WORKING WITH MY COLLEAGUES THIS SESSION ON THE MANY MAJOR ISSUES THAT WILL BE FACING US IN THE MONTHS AHEAD.

I COUNT MYSELF AS A SUPPORTER OF A STRONG, VITAL CIVIL SPACE PROGRAM. HOWEVER, I'M ALSO A STRONG BELIEVER IN MAKING SURE THE NATION GETS THE MAXIMUM RETURN ON OUR INVESTMENT IN SPACE--WHETHER THAT RETURN IS MEASURED IN NEW KNOWLEDGE, INCREASED COMPETITIVENESS, OR BENEFITS TO SOCIETY.

THIS MAY REQUIRE HOLDING NASA'S FEET TO THE FIRE OCCASIONALLY, AND I WON'T SHY AWAY FROM THAT. IT ALSO MEANS THAT THIS SUBCOMMITTEE INTENDS TO BUILD ON THE WORK OF THE AUGUSTINE COMMITTEE AND TO JOIN WITH THE REST OF THE CONGRESS, THE ADMINISTRATION, AND OUR INTERNATIONAL FRIENDS WHERE APPROPRIATE TO CRAFT A CIVIL SPACE PROGRAM THAT CAN CARRY US INTO THE 21ST CENTURY.

A KEY PART OF CRAFTING SUCH A PROGRAM WILL BE TO ENSURE THAT NASA IS EFFECTIVELY MANAGING WHAT IS ON ITS PLATE NOW, AND IS POINTED IN THE

RIGHT DIRECTION FOR ITS FUTURE PROGRAMS.

WE WILL START THAT PROCESS TODAY BY REVIEWING THE FY92 AUTHORIZATION REQUEST FOR NASA'S OFFICE OF SPACE SCIENCE AND APPLICATIONS. THE SPACE SCIENCE PROGRAM HAS HAD SOME EXCITING SUCCESSES OVER THE LAST YEAR, SUCH AS MAGELLAN, THE GALILEO FLYBY, AND THE COBE [KO-BEE] MISSION, AND A FEW MAJOR DISAPPOINTMENTS.

IN ADDITION, NASA HAS SOME MAJOR NEW PROGRAMS UNDER DEVELOPMENT, SUCH AS AXAF, CRAF-CASSINI, AND THE EARTH OBSERVING SYSTEM, THAT HAVE BEEN SUPPORTED BY THIS SUBCOMMITTEE, BUT WHICH ARE ENCOUNTERING PROBLEMS. WE NEED TO KNOW MORE ABOUT THE OPTIONS FOR THESE PROGRAMS. WE ALSO NEED TO KNOW WHAT THE PROSPECTS FOR SCIENCE WILL BE ON THE RESTRUCTURED SPACE STATION.

I'D LIKE TO TURN NOW TO MR. SENSENBRENNER FOR HIS REMARKS.

Mr. SENSENBRENNER. Thank you very much, Mr. Chairman.

Before welcoming our witness, I would like to congratulate you on assuming the chairmanship of the subcommittee, and I'm looking forward to a close working relationship with you over the next two years.

As the Augustine report so clearly pointed out, we cannot continue to run our Space Program under the "business as usual" approach. We cannot afford to undertake every appealing space project. We must carefully assess the total cost and technical challenges of all new projects before they are initiated. Once initiated, NASA and Congress must ride herd over these projects to keep them on track.

Mr. Chairman, the panel you have inherited has demonstrated aggressive oversight over the last several years. However, we occasionally contribute to the agency's problems by failing to estimate the availability of future funding and failing to establish firm priorities ourselves. I am optimistic these important lessons of the Augustine report will not be lost on our committee. I believe that working together we can provide the strong Congressional oversight and leadership which will be required during this critical period of our Nation's Space Program.

Today we kick off our subcommittee hearing agenda with NASA's Office of Space Science and Applications. This office faces several challenges and problems. I hope we can begin to learn more about these issues today so that this committee and NASA can begin working on a satisfactory resolution to them. As always, we welcome Dr. Fisk's testimony.

[The prepared opening statement of Mr. Sensenbrenner follows:]

OPENING STATEMENT OF

REP. F. JAMES SENSENBRENNER, JR.

SUBCOMMITTEE ON SPACE

FEBRUARY 28, 1991

MR. CHAIRMAN:

BEFORE WELCOMING OUR WITNESS, I WOULD LIKE TO CONGRATULATE YOU ON ASSUMING THE CHAIRMANSHIP OF THE SPACE SUBCOMMITTEE. I AM LOOKING FORWARD TO A CLOSE WORKING RELATIONSHIP WITH YOU OVER AT LEAST THE NEXT TWO YEARS.

AS THE AUGUSTINE REPORT SO CLEARLY POINTED OUT, WE CANNOT CONTINUE TO RUN OUR SPACE PROGRAM UNDER THE "BUSINESS AS USUAL" APPROACH. WE CANNOT AFFORD TO UNDERTAKE EVERY APPEALING SPACE PROJECT. WE MUST CAREFULLY ASSESS THE TOTAL COST AND TECHNICAL CHALLENGES OF ALL NEW PROJECTS, BEFORE THEY ARE INITIATED. AND ONCE INITIATED, NASA AND CONGRESS MUST RIDE HERD OVER THESE PROJECTS TO KEEP THEM ON TRACK. MR. CHAIRMAN, THE PANEL YOU HAVE INHERITED HAS DEMONSTRATED AGGRESSIVE OVERSIGHT OVER THE LAST SEVERAL YEARS. HOWEVER, WE OCCASIONALLY CONTRIBUTE TO THE AGENCY'S PROBLEMS BY FAILING TO ESTIMATE THE AVAILABILITY OF FUTURE FUNDING AND FAILING TO ESTABLISH FIRM PRIORITIES OURSELVES. I AM OPTIMISTIC THESE IMPORTANT LESSONS OF THE AUGUSTINE REPORT WILL NOT BE LOST ON OUR COMMITTE. I BELIEVE THAT WORKING TOGETHER, WE CAN PROVIDE THE STRONG CONGRESSIONAL OVERSIGHT AND LEADERSHIP WHICH WILL BE REQUIRED DURING THIS CRITICAL PERIOD IN OUR NATION'S SPACE PROGRAM.

TODAY WE KICK OFF OUR SUBCOMMITTEE HEARING AGENDA WITH NASA'S OFFICE OF SPACE SCIENCE AND APPLICATIONS. THIS OFFICE FACES SEVERAL CHALLENGES AND PROBLEMS. I HOPE WE CAN BEGIN TO LEARN MORE ABOUT THESE ISSUES TODAY, SO THAT THIS COMMITTEE AND NASA CAN BEGIN WORKING ON A SATISFACTORY RESOLUTION TO THEM. AS ALWAYS, WE WELCOME DR. FISK'S TESTIMONY.

THANK YOU.

Mr. HALL. Thank you.

The Chair recognizes the gentleman from California, Mr. Rohrabacher.

Mr. ROHRABACHER. I have no opening statement. Thank you very much, Mr. Chairman.

Mr. HALL. Okay, we'll get under way. I think to the very distinguished guests we have this morning I should first say not to judge the interest of the subcommittee by the attendance of the members, because it's more important that staff hear what you say and report to us in English exactly what you mean. [Laughter.]

We do have Dr. Lennard Fisk with us, Associate Administrator, Office of Space Science and Applications, accompanied by Al Diaz and Kathryn Schmoll. I think they're available for questions if we need and backup.

At this time, Dr. Fisk, we're honored by your presence, we'd be interested in your testimony, and we recognize you at this time.

STATEMENT OF DR. LENNARD A. FISK, ASSOCIATE ADMINISTRATOR, OFFICE OF SPACE SCIENCE AND APPLICATIONS, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, ACCOMPANIED BY AL V. DIAZ, DEPUTY ASSOCIATE ADMINISTRATOR, AND KATHRYN S. SCHMOLL, ASSISTANT ASSOCIATE ADMINISTRATOR

Dr. FISK. Thank you very much, Mr. Chairman. Allow me also to congratulate you and welcome you to your position as Chair, and I look forward to working with you over the next many years on this problem.

Mr. HALL. I think we may have gotten off to a bad start by me missing an appointment with you this morning, but I must tell you that I'll always take the best deal available, and the lady who is the Chairperson of the Redistricting Subcommittee in Texas was making a speech at the Texas Breakfast Club this morning, and I couldn't get up and walk out.

Dr. FISK. A wise choice.

Mr. HALL. I may not have had a district to walk back to. [Laughter.]

Dr. FISK. Your office provided a nice cup of coffee.

I have a written testimony, which I would be pleased to submit for the record.

Mr. HALL. Without objection.

Dr. FISK. Allow me, if I may, to just make some informal introductory remarks prior to your questions.

The Space Science Program of the United States continues to go along at a very active pace, a very exciting time for us, and allow me just to briefly report to you on some of the status of the ongoing missions. I believe you have before you a set of pictures that have come from some of our recent spacecraft, and just allow me to take a moment to page through them with you.

Magellan, of course, was launched in May of 1989 and is currently in the process of mapping Venus. We are about halfway through or about 60 percent through the first cycle of mapping the planet, and as you can see by this picture of the surface of Venus, we are getting extraordinary resolution on the surface. If you are a geolo-

gist, this is a picture which excites you greatly, because what you are able to see on Venus because there is no vegetation—it's too hot—and there's very little erosion so you essentially get to see the entire bedrock surface of the planet. Since Venus is essentially the same size as the Earth, we expect similarities between Venus and the Earth, and you're basically able to study a very similar planet to the Earth without all that debris on the surface of vegetation and rocks, which we enjoy but geologists do not.

Galileo, which was launched in October of 1989, has flown by Venus and has flown by the Earth last December and took this marvelous picture of the planet Earth. We saw no intelligent life as we passed by. [Laughter.]

There were some exciting science measurements done on that as well. We saw the back side of the Moon. You may recall that although we've been to the Moon many times, in the Apollo shots we always went when the front side of the Moon was lit, because we were planning to land on the moon. So we've never seen the back side of the Moon in full sunlight as we did in this, and there were many interesting measurements to be made along the way.

The Cosmic Background Explorer—this is a picture of the galaxy taken by COBE. The principal measurements of COBE are the radiation from the very beginning of the universe, and COBE is placing very real and very fundamental constraints on our understanding of the origin of the universe. It may be one of the most profound missions that NASA has ever flown.

Hubble is doing very well these days. We're in full operational phase. This is a picture Hubble took of the supernova that took place in 1987. We are fully operational on Hubble. We are essentially getting all of our fine guidance and course lock measurements, and so we're locking routinely on stars. We're operational at about 28 to 29 percent efficiency; 35 percent efficiency we consider to be the upper limit on what we could achieve. We are routinely turning out observations that are exciting the science community.

The spherical aberration is a problem for us only in the measurements of very faint, very distant objects. Whenever we're dealing with objects that are brighter than about a 25th magnitude star, which is about the best you can do from the ground, we can produce resolution with Hubble at a factor of three to 10 greater than any ground-based telescope, and this is producing some truly exciting scientific observations.

Finally, you have in your packet a picture taken from the Astro SpaceLab mission, which took measurements in the ultraviolet and produced several hundred really exciting observations in a wavelength and frequency range that we have not explored before, so, again, we're seeing some very fundamental observations of the universe in which we live.

This year will also be an exciting year for space science. Gamma Ray Observatory is scheduled to launch in April. The Upper Atmosphere Research Satellite goes in the fall. We have our first Life Sciences Spacelab mission in May. We have an International Microgravity Lab late in the fall. We are systematically following a strategic plan for space science and applications. This plan was laid down in 1988, and we update it each year, and we systematically

work our way through it and are continuing to do so. We're building for the future.

This is an interesting time for the Advanced X-Ray Astrophysics Facility—AXAF. We have a Congressional milestone to meet, which is polishing the largest mirrors for AXAF and producing resolution at half arcsecond. It is a tight schedule, a challenging job, but we're still intending to meet that milestone. CRAF/Cassini is under way. We've rebaselined the program to produce better launch opportunities, more mass margins, and to safely stay in the $1.6 billion Congressional cap on that program. EOS is under way. We have done the confirmation on the first EOS platform.

If I may just take a moment and comment on Mission to Planet Earth, of which, of course, EOS is an essential part, the one thing that is often lost on folks is that Mission to Planet Earth is not something that we wait for EOS to fly to execute. Mission to Planet Earth starts this year, and perhaps as is fitting because of the international aspect of that program, it starts with the launch of the European Earth Resources Satellite—ERS-1—in May, and it's followed by UARS, it's followed by TOPEX/POSEIDON to measure oceans, it's followed by numerous weather satellites. We will produce an enormous amount of data on the earth in the next few years and then evolve continuously into the observations by the Earth Observing System in 1998.

It's a little known or little understood fact that every one of the instruments that will fly on EOS—there is a precursor instrument, an instrument of less sensitivity, or in some cases, actually a comparable instrument—will fly on a spacecraft in advance of EOS. So EOS is a continuum from those things which will occur in the next few years. What EOS provides is, of course, greater sensitivity, and because you want to achieve this greater sensitivity, there are instruments flown simultaneously so you can make atmospheric corrections at the same time you're looking at the surface of the Earth, and, of course, continuity of measurements. We tie this whole program together with a very comprehensive data system which is intended to get data out to the science community very expeditiously in order that we can produce results very expeditiously.

Our plans for space station are going well. You will hear shortly, I'm sure, in the next few weeks from the agency about the plans for the restructured space station. We, of course, are also planning on our science use of that and are very pleased with the way the restructuring exercise is going in order to achieve the science that we want on the space station.

Finally, let me comment on that onerous thing—the budget. The budget you have before you does require substantial growth for the Office of Space Science and Applications in the 1992 budget. Please be aware, of course, that there is very little new in this budget. This budget is essentially the run-out of the 1991 budget. It's the funds required to execute those programs that we started in previous years and are under schedule in being able to execute.

I would be pleased to answer any questions.

[The prepared statement of Dr. Fisk follows:]

Statement of

Dr. Lennard A. Fisk
Associate Administrator for
Space Science and Applications
National Aeronautics and Space Administration

before the
Subcommittee on Space
Committee on Science, Space and Technology
House of Representatives

February 28, 1991

Mr. Chairman and Members of the Subcommittee:

I am pleased to have the opportunity to appear before the Subcommittee today to report on the status of NASA's space science and applications program and our plans for the future.

My focus today will be on three main themes: 1) NASA has a robust space science program, which is balanced among the core space science disciplines and which emphasizes the study of our own planet with the Mission to Planet Earth; 2) we have a Strategic Plan in place that will provide a roadmap for maintaining this robustness into the next century; and, 3) we have, as an agency, an appropriate balance between science and supporting infrastructure which will perpetuate the position of the United States as a world leader in space science research.

THEME 1:

This is my fourth year of presenting the space science and applications program to this Subcommittee. Over the past 3 years we have seen the evolution of a program full of promise and potential to a program of accomplishments. We are in the midst of one of the most exciting and interesting periods in the history of space exploration -- a period referred to as the "Second Golden Age of Space Science." This "golden age" holds the potential for expanding our knowledge and understanding of scientific phenomena ranging from the intricacies of the universe to the subtleties of our very own planet. Over the next few years we will see an ever increasing level of activity in space science. Many of our planned missions are moving forward in their development and construction, culminating in their launch and operation. The resulting return in scientific data will be astounding in its depth and breadth.

Although the "golden age" to date has been primarily focused in the areas of astrophysics and planetary exploration, this year will see us embark on the exploration of our own planet with Mission to Planet Earth. Mission to Planet Earth is unlike any other NASA space science program. It is not intended to increase incrementally our knowledge of Earth. Rather, it is intended to increase with all due haste our knowledge of all aspects of the Earth system to a sufficient level of understanding to assist in making sound policy decisions.

During the next several years, our knowledge of Earth should increase substantially, as NASA will participate in 19 Earth science missions to study various aspects of how the Earth works. This year will see the launch of the Upper Atmosphere Research Satellite (UARS) which will make definitive measurements of the chemistry and dynamics of the upper atmosphere, and thus of ozone depletion. It will be followed next year by TOPEX/POSEIDON which will reveal more about the circulation of the the world's oceans than all the ships in history. The NASA Scatterometer will study wind stress on the oceans. The ATLAS Spacelab missions will study the atmosphere, and the Shuttle Radar Laboratory will observe the topology of the land. Our international partners, the Japanese, the Europeans and the Canadians, will also launch 7 missions, some of which will carry U.S. payloads, and many of which we will help track in return for access to their data. And the National Oceanic and Atmospheric Administration will continue to operate meteorological satellites.

The FY 1992 space science and applications budget focuses on three themes: the timely execution of core space science missions, the vigorous pursuit of Mission to Planet Earth, and increased support for basic research. These themes are consistent with the recommendations of various outside advisory bodies and the guidance of the Congress. There is, however, one major difference in this budget compared to those I have presented to you in previous years. The FY 1992 budget request does not include a major new start for space science. Rather this budget, with its growth over the FY1991 budget, simply allows us to continue on schedule the missions and programs committed to in previous years by the Administration and the Congress. The proposed budget does include

funding for a new small mission to develop a recoverable life sciences satellite called Lifesat. This satellite will help to define radiation protection requirements for the long-term habitation and exploration of space and thus constitutes a key contribution to Mission from Planet Earth. Another critical element of the FY 1992 budget is an augmentation to the research and analysis program -- which is the critical lynchpin to a world class science research community in universities and NASA centers.

I believe that the budget presented to you is a balanced space science and applications budget; we are approximately 20 percent of the NASA budget and the resources are applied in accordance with the themes of the Space Science and Applications Strategic Plan. We need your support for this budget in order to assure the health and well being of the current operational program, as well as programs in development.

Permit me now to describe in more detail some of our recent accomplishments and our plans for 1991.

1990: A Year of Successes and Challenges

The year 1990 was one of extraordinary activity for space science, perhaps the most active year in several decades. Launches included Pegsat, the Hubble Space Telescope, the Roentgen Satellite, the Combined Release and Radiation Effects Satellite, Ulysses, and the flight of the Astro Spacelab mission. Missions launched in 1989 also successfully met major milestones in 1990, including Galileo's Venus and Earth flybys, the Cosmic Background Explorer sky survey, and the initiation of the Magellan mapping phase.

The Hubble Space Telescope (HST) of course presented challenges with the discovery that its primary mirror exhibits spherical aberration. This problem notwithstanding, HST is proving itself to be an exemplary observatory, capable of seeing objects in visible light much more clearly than ground based telescopes and making extraordinary observations in the ultraviolet wavelengths, which are obscured from the surface by the Earth's atmosphere. HST is the world's premiere astrophysical observatory today; and we remain confident that over the next few years we will successfully restore as much of HST's original capabilities as is technically and scientifically prudent.

More immediately, NASA scientists analyzed global temperatures from the 1980's to offer insights into potential global warming. Though no net trend could be seen within the last decade, observations indicated that the 1980's were warmer than the 1970's. NASA also expanded its commitment to study the Earth, receiving approval from Congress to begin the Earth Observing System (EOS), a series of satellites that will use the perspective from space to observe the Earth as a global environmental system, and to provide the space-based measurements required by the U.S. Global Change Research Program.

We continue to proceed in our commitment to understand the changes occurring in our own planet Earth. In January, we selected the payload of 11 instrument investigations for the first spacecraft in the EOS-A series to provide a concentrated and coordinated study of the causes and effects of global warming. The final determination of the instrument manifest on subsequent satellites will be made after development is underway on the initial set. This approach is intended to allow for the continuing evolution in mission planning that is expected to result from the development of new technology, improved understanding of measurement requirements, and the availability of alternative sources of data.

The second spacecraft series, EOS-B, currently planned for flight 2-1/2 years later, is devoted to measurements of tropospheric and stratospheric chemistry, ocean circulation, glaciology, and plate tectonics. In contrast to the initial EOS-A spacecraft, which carries a full suite of instruments on a single spacecraft, the EOS-B series may be conducted using multiple smaller spacecraft with smaller numbers of instruments per spacecraft. We are actively studying how best to implement this approach.

It is important that as we execute the EOS program we continually review it to ensure that we are proceeding in a cost-effective and timely manner that will yield the scientific results required by the U.S. Global Change Research Program. Accordingly, we will subject EOS this year to an external engineering review.

Our international partners, the European Space Agency (ESA) and Japan, are planning to build spacecraft that include accommodations for U.S. scientific instruments. Supplementing these core components will be a series of smaller Earth Probe satellites with specialized instrumentation and orbits for investigations that cannot be accomplished otherwise.

To make optimum use of the data from these upcoming missions, we intend to improve computational capabilities in Earth science, and to enhance the access of researchers to these data through networks and archiving facilities. The EOS program includes an EOS Data and Information System (EOSDIS), essential elements of which will be brought online in 1994, in advance of the launch of the EOS spacecraft. EOSDIS will be used to derive maximum information from existing and upcoming missions, and , in turn, the data from these missions will be used to test and perfect EOSDIS in advance of the larger data flows from the EOS spacecraft.

Data alone do not yield understanding. Understanding requires scientists interpreting the data, developing concepts for the processes that control Earth, and building predictive models of its future. The EOS program will include funding to effectively double the research community that will dedicate itself to understanding global change.

Significant progress in the Life Sciences was made in 1990. The Extended Duration Medical Program made substantial progress toward documenting the physiological changes that potentially affect Space Shuttle crews' capability for

landing and egress. Investigations were flown on all five Shuttle missions during 1990. The program is on schedule to support a 13-day flight of the United States Microgravity Laboratory (USML-1). In addition, the NASA Specialized Centers of Research and Training (NSCORT) program was initiated with three Centers being selected: Kansas State University, Purdue University and the University of Rochester.

In 1990, we conducted approximately 30 suborbital rocket flights and 25 balloon flights in support of space science. Space science missions conducted during 1990 included major, moderate and small missions, reaffirming NASA's continuing commitment to a balanced space science program.

1991: Another Promising Year for Space Science

This year will build on the successes and lessons learned in 1990; providing us with additional early returns from missions launched during the last 2 years, and a sequence of exciting new launches. These new launches, along with the continued development of planned missions, constitute important investments in our country's future.

NASA's recently released launch manifest calls for five major space science launches in 1991; four on the Shuttle and one aboard an expendable launch vehicle. Launches of the Gamma Ray Observatory, the Upper Atmosphere Research Satellite, the Extreme Ultraviolet Explorer, and two Spacelab flights: the first Space Life Sciences mission and the International Microgravity Laboratory, all reflect significant strides in these various science disciplines. In addition to launches, Magellan will complete its primary mapping mission and Galileo will obtain data on its flyby of the asteroid Gaspra, both of which are significant scientific milestones.

The Soviet Union is scheduled to launch NASA's Total Ozone Mapping Spectrometer (TOMS) on one of its "Meteor" remote sensing satellites during August. This instrument will complement the long-term data set being gathered by a TOMS instrument on Nimbus-7, which has operated since 1978. It will also allow time series evaluations of environmental trends to continue through the end of the century, providing increased insight into global and regional changes in ozone concentrations. This cooperative mission with the Soviet Union will be followed later by the launch of identical TOMS instruments on a U.S. spacecraft in 1993, and on a separate Japanese spacecraft in 1995. All three missions will serve as precursors to NOAA instrumentation planned for use in the Earth Observing System (EOS) program.

The Advanced X-ray Astrophysics Facility (AXAF), the X-ray element of NASA's Great Observatories program, will pass a major programmatic milestone later this year with the completion of the fabrication and initial testing of its first pair of X-ray mirrors. AXAF, the third Great Observatory, is scheduled to be launched in the late 1990's and will operate for approximately 15 years. AXAF will focus on the "violent" universe, investigating the existence of stellar black holes and dark matter,

and the processes surrounding galaxy clusters and superclusters, supernovae, neutron stars and stellar evolution.

NASA will launch our Nation's first Global Change satellite, the Upper Atmosphere Research Satellite (UARS), in November. UARS will provide a global database necessary for understanding the chemistry, dynamics and energetics of the upper atmosphere and the effects of solar radiation on these characteristics. UARS will also explore the susceptibility of the upper atmosphere to long-term changes in the concentration and distribution of key atmospheric components, particularly ozone. UARS will be a key component of NASA's long-term program in upper atmospheric research.

Mr. Chairman, 1991 is shaping up to be another impressive year for NASA's space science and applications program. However, as we move forward into the future, we cannot lose sight of our strategic direction. As more and more planned launches become reality, the natural tendency is to become concerned only with the immediate future, to concentrate only on the next milestone or the next mission. We remain committed to ensuring that our Nation's space science program does not become a victim of short-sightedness.

THEME 2:

Since 1988, the Office of Space Science and Applications (OSSA) has had in place a comprehensive strategy for managing our programs. The elements of the OSSA Strategic Plan have remained constant throughout, namely: 1) Establish a set of programmatic themes; 2) Establish a set of decision rules; 3) Establish a set of priorities for missions and programs within each theme; 4) Demonstrate that the strategy can yield a viable program; and, 5) Check the strategy for technology readiness and for consistency with resource constraints, such as budget, workforce, facilities, and launch vehicle availability.

To date, the OSSA Strategic Plan has served NASA and the Nation well, providing us with a clear vision of the future of space science and a detailed strategy for making that future a reality. The Strategic Plan has guided our actions over the last 3 years and has been adapted, as necessary, to meet the changes and challenges that have arisen. The 1991 Strategic Plan reflects a transitional year in which we focus on carrying out the ongoing space science program and strengthening our research base to reap the benefits of current and future missions. The Plan is built on interrelated, complementary strategies for the core space science program, for Mission to Planet Earth and for Mission from Planet Earth. Each strategy has it own unique themes and mission priorities, but they share a common set of principles and a common goal -- leadership through the achievement of excellence.

The OSSA Strategic Plan has aged well because it is built on a solid foundation of consensus among the major groups interested in space science, and because it has been updated annually to ensure that it remains consistent with the realities of the 1990's. The OSSA Strategic Plan reflects a comprehensive and

balanced space science program, proposed by NASA with guidance from the science community; a plan that the Congress and the Administration have endorsed. It reflects the reality of the current constrained fiscal environment, proposing no major New Starts during Fiscal Year 1992. It contains increased emphasis on, and additional funding for, Research and Analysis (R&A) activities; reflecting NASA's continuing responsiveness to the requirements of the scientific community. And it remains consistent with the recommendations of the Advisory Committee On the Future of the U.S. Space Program (Augustine Committee).

NASA remains firmly committed to fulfilling the OSSA Strategic Plan in its entirety, as called out in the Augustine Committee's report: "Recommendation 2: That, with respect to program content, the existing strategic plan for science and applications proposed by NASA with input from the science community be funded and executed."

The next edition of the OSSA Strategic Plan should be available shortly. Consistent with our intent to keep the plan timely, OSSA will be spearheading a comprehensive review of the Strategic Plan this coming Summer with significant input from the scientific community. Our goal is: to extend the duration of the Strategic Plan through the end of this century and into the early years of the next; to establish our priorities for space science missions through Fiscal Year 1998; and to assess the likely priorities for the period Fiscal Year 1999-2003. This months-long effort will culminate in a week-long workshop in August with our advisory committees.

THEME 3:

Finally, Mr. Chairman, I would like to address NASA's commitment to assure U.S. leadership in the field of space science and applications. This is not attained merely through budgetary support for the space science and applications program. Rather it is the entire NASA institution -- the people, the facilities, the resources -- together with the university community and industry that are responsible for a world class science program. The space science and applications program depends on all elements of the NASA program to be world class -- the Shuttle, the Space Station, the Deep Space Network, the Expendable Launch Vehicles, the Tracking and Data Relay Satellite System, the Space Research and Technology Program -- you cannot have one without the other elements. It is the commitment to investments for the future workforce, to assure a world class science program -- both for this program as well as the other elements of the agency. It is the initiation of Global Change Research Fellowships that will nurture the future researchers to push towards an understanding of the feedback systems of our fragile environment. The budget that you have before you for NASA is a balanced one, which provides the needed support for space science and applications across the entire agency, and which without such support the space science and applications program cannot succeed.

SUMMARY:

As we begin 1991 and look forward to 1992, our Nation's space science program is doing well and its future appears bright. A number of NASA's major missions have already, or will within the next year, enter into their primary operation phase. During 1991 and 1992, we can expect that missions such as HST, COBE, Magellan, and Galileo, will continue to produce new discoveries and contribute to the ever growing body of scientific knowledge.

Additional missions scheduled for launch during 1991-1992 will build on lessons learned from previous space science missions, as well as initiating some important firsts. During this period, NASA will launch the first in a series of missions dedicated to understanding global change, the Upper Atmosphere Research Satellite (UARS). NASA will also make considerable progress on the newly approved Earth Probes program, opening the door to even more advances in our understanding of global atmospheric and environmental trends. We recognize the urgency to pursue these missions with deliberation and speed; we are proceeding under this premise.

Progress is anticipated during 1991-1992 for a number of major programs currently under development. The Earth Observing System (EOS), Advanced X-ray Astrophysics Facility (AXAF) and CRAF/Cassini missions will be completing a number of major programmatic milestones. On these and other missions, NASA is building the ground work in 1991 for new discoveries in 1992 and beyond; some missions will not reach their primary operational phase until late in the 1990's, or early in the next century. A more detailed status for OSSA's major missions is contained in the enclosure entitled "Status of Major Missions."

It is clear that a new era in space science has begun. The decade of the '90's will be a very important time to concentrate our efforts on reaping the benefits of the data obtained from missions recently launched, and to continue the development of future missions approved over the last few years. Some of these missions are just beginning to bear fruit, while others are just getting off the ground. Many of the newly approved missions are entering crucial phases of their development and will need to be nurtured carefully. It is our mutual responsibility to assure that we stay on course and look to the future. We have a responsibility to future generations to nurture the various elements of this program to better understand our Earth and the universe in which we reside. NASA remains committed with the help of this Committee and the Congress, to ensure that our vision of the future becomes a reality.

STATUS OF MAJOR MISSIONS

• OPERATIONAL MISSIONS

Hubble Space Telescope (HST)
Launched on April 24, 1990, HST's flight and ground systems are all operating within specification, with the exception of the effects of spherical aberration in the primary mirror and disturbances ("jitter") resulting from thermally-induced problems with the solar arrays. The spherical aberration problem is now well understood; the Optical System Board of Investigation (Allen Board) issued its final report on the cause of this problem on November 27, 1990. Work continues, in consultation with the European Space Agency (ESA), on measures to alleviate the effects of the solar array-induced disturbances.

All of HST's science instruments are now fully operable. Orbital Verification was completed during November 1990; Science Verification continues to progress well with completion scheduled for November 1991. Guest Observer (GO)/Guaranteed Time Observer (GTO) programs are being integrated into the remainder of Science Verification. Outstanding science results continue to accrue from the first of NASA's Great Observatories with several images being released since May 1990, including recent Saturn observations that continue to demonstrate HST's ability to conduct world-class science. In fact, a special session of the 1991 American Astronomical Society (AAS) winter meeting was devoted to results from HST. Progress continues on plans for the 1993 Servicing Mission. The basic payload consists of the replacement Wide Field/Planetary Camera (WF/PC II) and the second solar array set. A replacement gyro package and additional optical system corrections are under study.

Cosmic Background Explorer (COBE)
Launched on November 18, 1989, the Cosmic Background Explorer (COBE) spacecraft continues to operate nominally. COBE completed its all-sky survey during June 1990, and depleted its on-board helium supply, as expected, in September 1990. All six Differential Microwave Radiometer (DMR) channels and four of the six bands of the Diffuse Infrared Background Experiment (DIRBE) continue to collect science data.

COBE's significant scientific accomplishments continue to astound and impress the scientific world. During 1990, COBE produced the most precise measurement of the Big Bang infrared spectrum, the first near infrared image of our Milky Way Galaxy, and the most precise anisotropy maps assembled to date. COBE's near infrared image of our Milky Way Galaxy was selected by Popular Science Magazine as one of the "100 Best of What's New for 1990."

Galileo
Since launch on October 18, 1989, Galileo has traveled over 790 million miles and is approximately 33 million miles from Earth. Its principal mission is to study the planet Jupiter, its atmosphere, magnetosphere, and four Jovian satellites. Galileo's

performance to date has been excellent. Galileo's Venus gravity assist flyby was successfully completed in February 1990. Data from this Venus flyby was downlinked in November 1990, providing the best visible light imaging obtained to date and the first ever infrared imaging and spectroscopy below Venus' cloud deck. In December 1990, Galileo flew by Earth, providing impressive scientific data (and over 3000 images) of the Earth/Moon system. While Galileo is on its journey to Jupiter, the spacecraft will continue its collection of interplanetary data. Scientists and engineers are planning for the spacecraft's asteroid encounters and Jupiter tour.

Magellan

Launched on May 4, 1989, Magellan was inserted into orbit around Venus on August 10, 1990. Radar mapping activities are proceeding smoothly, with over 780 orbits successfully mapped since initiation of mapping on September 15, 1990. To date, over half of the planet's surface has been mapped. At the time that Magellan's prime mission ends on May 15, 1991, our scientific mission objective to map at least 70 percent of the planet's surface will have been achieved. Scientific results released to date have been impressive; a special session at the fall meeting of the American Geophysical Union (AGU) in December 1990 was devoted to Magellan.

Meanwhile, the spacecraft continues to operate well with only minor anomalies. The loss of signal events that have occurred since Venus Orbit Insertion (VOI) are still not well understood and could reoccur. The loss of data events have been typically associated with anomalous star calibrations or telecommunication interruptions. Problems with the operation of the onboard data recorders are in work. Tape Recorder A was turned off December 22, 1990, and Tape Recorder B was switched on. Troubleshooting on Tape Recorder A to characterize the problem and identify possible solutions continues.

Ulysses

Ulysses is a cooperative mission with the European Space Agency (ESA) to study the Sun at high polar latitudes. Since it was launched aboard the Space Shuttle *Discovery* on October 6, 1990, the Ulysses spacecraft has traveled approximately 258 million miles. In February, Ulysses is approximately 108 million miles from Earth. The spacecraft is now performing well. By mid-December 1990, the spacecraft "wobble" was under control, and an appropriate strategy is in place to handle recurrences.

The spacecraft's power and propulsion systems are currently performing well and the thermal condition of the spacecraft is good. Routine operations commenced in January 1991; operational control was transferred from the European Space Research and Technology Center (ESTEC) to the European Space Operations Center (ESOC) in early January. Subsequent to post launch checkout activities and instrument calibrations, all science instruments are operating and returning data. Trajectory corrections have been successfully completed in preparation for the Jupiter gravity assist scheduled for February 1992, this maneuver will propel

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Ulysses out of the ecliptic plane and into position to observe the Sun's polar regions.

Combined Release and Radiation Effects Satellite (CRRES)
On July 25, 1990, the Combined Release and Radiation Effects Satellite (CRRES), a cooperative program with the U.S. Air Force, was successfully launched into orbit. CRRES, with its 24 chemical canisters, is designed to study the Earth's magnetic and electrical fields and radiation belts. The release of lithium and barium ions from these canisters creates an artificial aurora borealis which is used to trace the field lines of the Earth's magnetosphere. The South Pacific chemical release campaign in September 1990, first Northern Canada high altitude campaign in January 1991, and the second Northern Canada high altitude campaign in February 1991, have been successfully completed with two, six, and two releases, respectively. The purplish barium and red lithium clouds were observed and tracked by ground stations, scientific aircraft and satellites. A sounding-rocket campaign in the South Pacific made sub-orbital studies in conjunction with the CRRES satellite. Releases from a similar mission, Pegsat, were seen in the Spring over parts of Northern Canada. Additional Caribbean releases are planned for July/August 1991.

• UPCOMING LAUNCHES

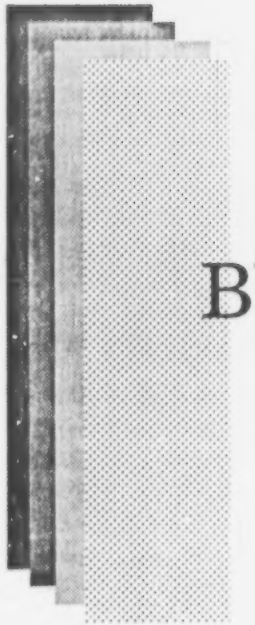
Gamma Ray Observatory (GRO)
Significant progress has been made in preparation for the launch of the Gamma Ray Observatory (GRO). The high gain antenna has been installed on the spacecraft, and the fueling of its onboard propulsion system is now complete. GRO's final functional test was completed during December 1990. GRO was moved into the Vertical Processing Facility (VPF) on February 7, 1991, and is currently undergoing payload preparations for installation into the Space Shuttle Orbiter (*Atlantis*) during March 1991. All preparations are on schedule for a launch readiness date of April 4, 1991, for the second of NASA's Great Observatories.

Spacelab Life Sciences Mission (SLS-1)
A Spacelab module outfitted for the first Spacelab Life Sciences Mission, SLS-1, has been decabled from the Cargo Integration Test Equipment (CITE) test stand, awaiting transfer to the Orbiter Processing Facility (OPF) during March 1991. SLS-1's last Mission Integration and Training Simulation (MITS #10) was conducted on February 12, and focused on Flight Day 1. SLS-1's four Joint Integrated Simulations (JIS #1-4) are scheduled for March/April 1991, and its installation into the Space Shuttle Orbiter (*Columbia*) is planned for March 1991. SLS-1 is on schedule for a May 1991 launch readiness.

Upper Atmosphere Research Satellite (UARS)
The final integration and test of the Upper Atmosphere Research Satellite (UARS) observatory is underway. Nine of the ten UARS instruments have been redelivered to General Electric. The final UARS instrument is expected to be delivered in February 1991, with completion of observatory reassembly and testing expected

during March 1991. After delivery of the final computers, the UARS Central Data Handling Facility (CDHF) is now up to its full capability of 140 million instructions per second. The UARS mission crew was assigned in December 1990. UARS will be delivered to the Kennedy Space Center (KSC) during the Summer of 1991 and will later be integrated into the Shuttle in support of a November 1991 launch readiness.

International Microgravity Laboratory Mission (IML-1)
Preparations continue on the first International Microgravity Laboratory Mission (IML-1), a NASA Spacelab mission with international participation (Canada, European Space Agency, France, Germany, and Japan) that will focus on material and life sciences in the microgravity environment. The payload has successfully completed experiment testing at the Kennedy Space Center and is now assembled and undergoing integrated module laboratory testing. Originally manifested for launch on the Space Shuttle *Columbia*, IML has been remanifested on *Atlantis* to permit *Columbia* to undergo modifications and inspection. Meetings have been held with the Principal Investigators to replan for the reduction in mission time from 9 to 7 days. Training of the mission crew is continuing and mission integrated simulations are planned for later this year. Checkout of the IML-1 payload is expected to be completed by mid-year, in support of a December 1991 launch readiness.



BUDGET DETAIL

FY 1992 OSSA BUDGET REQUEST

(Dollars in Millions)

PROGRAM	FY 1991 BUDGET	FY 1992 REQUEST
Physics & Astronomy	**975.1**	**1140.6**
Gamma Ray Observatory Development	22.0	0.0
Global Geospace Science	96.6	65.3
Adv. X-Ray Astrophysics Facility (AXAF)	101.2	211.0
Spacelab Payload Msn. Mgmt. & Integ.	88.8	88.0
Space Station Planning/Attached P/L	3.0	0.0
Payload & Inst. Development	94.6	115.9
Explorer Development	99.8	107.9
Mission Operations & Data Analysis	313.3	388.4
Research & Analysis	100.8	103.1
Suborbital Program	55.0	61.0
Planetary Exploration	**457.1**	**627.3**
Mars Balloon Relay	1.5	1.2
Ulysses Development	3.0	0.0
Mars Observer Development	78.5	54.4
Mission Operations & Data Analysis	161.2	150.5
Research & Analysis	67.9	93.2
CRAF/Cassini	145.0	328.0

SP-072-19c
2/27/91

FY 1992 OSSA BUDGET REQUEST

(Dollars in Millions)

PROGRAM	FY 1991 BUDGET	FY 1992 REQUEST
Life Sciences	**138.0**	**183.9**
SETI	12.1	14.5
Human Flt./Sys. Engineering	58.3	58.6
Space Biological Sciences	22.8	31.1
Research & Analysis	44.8	64.7
Radiation Biology Initiative/LIFESAT	(2.0)	15.0
Space Applications		
Earth Science & Applications	**667.9**	**775.6**
Earth Science Payload Inst. Dev.	49.7	48.6
Mission Operations & Data Analysis	39.4	56.3
Upper Atmosphere Res. Satellite	64.0	18.2
Ocean Topography Experiment	76.0	51.9
Interdisciplinary R&A	12.4	2.5
Modeling & Data Analysis	44.3	45.0
Process Studies	107.5	114.3
Research Facilities	28.9	29.6
Earth Observing System	191.0	336.0
Earth Probes	54.7	68.2
Remotely Piloted Aircraft		5.0

SP-072-17c
2/27/91

FY 1992 OSSA BUDGET REQUEST

OSSA

(Dollars in Millions)

PROGRAM	FY 1991 BUDGET	FY 1992 REQUEST
Materials Processing in Space	**102.3**	**125.8**
Research & Analysis	13.7	16.6
Materials Experiment Operations	84.9	85.5
Space Station Utilization	(3.0)	21.3
Commercial Microgravity R&D	3.7	2.4
Communications	**52.5**	**39.4**
Search & Rescue Transition	1.4	1.3
Research & Analysis	17.1	26.9
ACTS Development	34.0	11.2
Information Systems	**36.7**	**42.0**
TOTAL OSSA	**2,429.6**	**2,934.6**

SP-072-18d
2/27/91

Mr. HALL. Thank you very much.
The Chair recognizes Mr. Sensenbrenner.

REALISM OF STRATEGIC PLAN

Mr. SENSENBRENNER. Thank you very much, Mr. Chairman.

On pages 6 and 7 of your statement, Dr. Fisk, you talk about the OSSA strategic plan, and you state that "it reflects the reality of the current constrained fiscal environment, proposing no major new starts in fiscal year 1992." Now, this still requires about a 21 percent increase in your budget over 1991, from 1991 to 1992, with no major new starts.

I'm concerned that increases of this nature as we continue in this decade are not sustainable in the current fiscal environment, because the Federal budget deficit isn't going to go away, and I think that the Congress, during this decade, is going to be more and more engrossed in how to get a handle on the Federal budget deficit and hopefully get us to a balanced Federal budget than perhaps the Congress in the last decade.

Now, you project a 22 percent increase in space science for 1993 and a 15 percent increase for 1994 just to handle the run-out. Do you think that this strategic plan really makes sense if it requires huge percentage increases such as those that I have described just to keep the existing programs going, and anything that is new would be over and above that?

Dr. FISK. The answer is I hope it's realistic. Let's analyze that, though, in a little more detail before——

Mr. SENSENBRENNER. If I may interrupt, the burden of proof is on the plaintiff.

Dr. FISK. I'm sure that's true. The growth in the budget this year is, of course, to execute the programs which were started in previous years—the AXAF, CRAF/Cassini, and beginning of EOS—and it requires a growth in space science and applications which is larger than the agency as a whole. I think you always have to judge the space science budget in the context of the overall agency budget, which is, of course, a lesser growth than the 20-some-odd percent required for space science.

In subsequent years, the growth in the OSSA budget will be primarily driven by the Mission to Planet Earth. If you look at the core science program—the AXAFs, the CRAF/Cassinis, the basic R&A, the operational costs, and so forth—then that growth, of course, levels off after about 1992 or 1993 at a much more modest growth percentage. So I think the question that we will have to wrestle with is do we wish to execute the Mission to Planet Earth, and if we do, then there is a cost growth required in the program.

Please, if I just may finish on that point, one of the things that we have repeatedly said about the Mission to Planet Earth is that it is a program that is intended to be very comprehensive. If you look at the science that you're trying to achieve, you really want to ask yourself do you want to understand global change with sufficient accuracy so that you and your colleagues and others can make sound policy decisions on the future of the planet, and then you have to do a comprehensive program. And if you want to do a

comprehensive program, the breadth of that program does imply a fairly big price tag.

Mr. SENSENBRENNER. Let me try to put this in perspective. To limit the growth of OSSA to 21 percent, Mission to Planet Earth took about a $175 million cut from what had been proposed just a year ago, and I don't know if there were any cuts in the 22 percent figure for fiscal year 1993 and the 15 percent figure increase for fiscal year 1994. Obviously, NASA and OMB decided that to give you the generous increase of 21 percent there had to be a pretty significant hit from Mission to Planet Earth, and I guess my concern is that if this is going to be carried out not only for the next fiscal year but for the outyears as well, we're going to have to have a significant review on what this is to accomplish, because if it's $175 million a year for each of the next 10 years, that adds up to a pretty good piece of change.

Dr. FISK. That's a good question. Let me address it head-on here. We have just done, of course, the confirmation on the first EOS-A platform, and we very deliberately chose a modest payload for that platform. We did not fly, for example, the High-Resolution Imaging Spectrometer, which is a multi-hundred million dollar instrument of great technical challenge to us, and we chose instead a payload of instruments which are essential to do global warming and global change studies but which are modest in their effort.

As a result of that, we were in fact able to take required funds out of this program, still maintaining the launch schedule of December 1998 of the first platform, and those corrections have been made to the run-out budget. So the budgets that you have before you, including the percentage increases that you cite, are the ones that will execute the program as you see it at the moment—the launch of the EOS-A platform with a payload that has just been confirmed in the construction of the data system.

I would really hope that no further changes in that program or budget would be required in the next few years, because this is a very minimum program. This is a program which is down to the core science that needs to be accomplished, and anything less than that would not cover some essential aspect of global change.

Now, it's important to note perhaps that the changes in this budget profile are actually ones that were volunteered by NASA, because when I looked at the original budget profiles for Mission to Planet Earth in the 1993 and 1994 time frame, I thought they were unattainable in today's budget climate. I hope the ones we've presented to you today are not unattainable.

Mr. SENSENBRENNER. Thank you very much, Mr. Chairman.

Mr. HALL. The Chair recognizes Mr. Rohrabacher.

SPACE STATION ASSESSMENT

Mr. ROHRABACHER. Dr. Fisk, did you say that—I don't remember your exact words, but I was rather stunned that you were giving a positive assessment to the situation of the space station. I mean, it's almost as if Saddam Hussein is giving a positive assessment to the war effort. [Laughter.]

Maybe you could make it clear to me just why we should be at all positive about what's going on with the space station.

Dr. FISK. I won't try and comment on the analogy with Saddam Hussein, but the——

Mr. HALL. I can help you a little there, if you'd like. [Laughter.]

I read this morning where, with Saddam Hussein's statement, we might reconsider the fact that Custer probably really won that battle. [Laughter.]

Go ahead, Doctor.

Dr. FISK. Let's review this situation as I see it here. As Mr. Sensenbrenner was just saying, we face some very real budgetary problems in NASA, simply because the growth required in the budget is going to be difficult to obtain in the overall budget climate that you face. That was a problem which was recognized last year by the Congress and by the Administration, so they placed essentially a funding limitation on the space station that says it's $2.1 billion and grows at 10 percent or so over the next few years.

The challenge to the agency has been to come up with a very viable space station program which meets two constraints. One is that it fits within that budget profile, and two, that it is buildable, that we are talking about something which we are confident can be executed. I think the people that are working this restructuring exercise, as I think you will find when you get a chance to review this, have done an admirable job in meeting those two constraints.

Then the issue is, well, can the users use this thing? What sort of science will we get from that, both in the microgravity materials and in life science research? And the interface there has been very good in our placing constraints, placing requirements on this, asking them to make some changes in their design to meet the needs that the user has, and I've been very pleased by the outcome. Fortunately, the kinds of things that we asked them to worry about which were above and beyond the things that they were doing in part of the restructuring exercises were fairly easy to accommodate, and so I think although you're going to find the station is smaller, you're going to find that the station spends more time in a man-tended mode, that it is an affordable, buildable, and usable space station.

Mr. ROHRABACHER. Do you think that when we first embarked on this project that perhaps people were being unrealistic?

Dr. FISK. You and I, when we make this analysis, have the virtue of considerable hindsight, and I think in the context of hindsight, yes. But I doubt that in 1984 we could have predicted S&L bail-outs or deficits growing to several hundred billion dollars and so on, so I think it would be uncharitable of me to be too critical of the decisions that were made back in that time frame.

HUBBLE SPACE TELESCOPE

Mr. ROHRABACHER. Well, usually when people make mistakes in the private sector, they get fired, and usually if they make miscalculations that cost billions of dollars for their company, they no longer are put in the position to make those decisions. Frankly, I'm not sure whether that's justified in terms of the space station. Perhaps you're right. Perhaps it's just something that someone who is just really doing his job and not being overly optimistic would have made a judgment that was just based on the information at the

time, and you can't blame him for it. But there are other things that certainly have gone on with NASA in particular that I just don't see much of an accountability, and one specific area dealt with the Hubble Telescope, and I'd like to ask you a little bit about that.

Apparently, there was an investigation led by General Lou Allen, and the results were reported to you last November, and I'd like to know has there been any administrative action taken concerning whatever was the outcome of that report? I guess I'll be very, very blunt about it. Has anyone been fired over this fiasco?

Dr. FISK. Let me answer this very carefully here. The Allen report did come in, of course, and that was designed to answer one question, which is what happened? I mean, we asked a very technical question of that group. We didn't ask them to assess blame. The matter of dealing with the contractual issues on this and any subsequent issues to that is an active issue still under review in the agency, and if I may, I'd prefer not to discuss it in this audience.

Mr. ROHRABACHER. Well, then I would assume that the people who made those decisions are still in positions of authority.

Dr. FISK. Again, you have to deal, of course, with the—if you're asking the question of the people in Perkin-Elmer, which was the contractor in question—which, of course, has been sold to Hughes-Danbury a couple years ago—if you're asking are any of those people who participated in the construction of the mirror still employed by that company, the answer is no. I can't tell you they were fired, because this is now 10 years ago, and for various reasons——

Mr. ROHRABACHER. However, some of the people responsible for overseeing their work at the Government level are in fact still there.

Dr. FISK. There are certainly people that are still there, but please bear in mind that the conclusion of the Allen report was that the information that revealed there was a potential problem in the construction of the mirrors on the Hubble Space Telescope was not revealed to the agency.

Mr. ROHRABACHER. All right. I will respect and I do respect your desire to try to look at this privately and not try to ruin anybody's life over mistakes that may or may not have been made, but let me ask you this. There has been a report that Hughes-Danbury is being considered—or at least NASA is still considering giving them an award fee for their work on the Hubble Telescope. Is that correct?

Dr. FISK. I'd have to check on this issue. I can assure you they're not going to get an award fee or any additional award fee for the mirrors. That's not an issue. The issue that you always face with award fees is that they are normally segmented by the part of the contract on which they are to be applied. The mirrors in the case of the Hubble Space Telescope, although they were a very essential portion of the telescope, were a small financial portion of the total contract.

I mean, what Hughes-Danbury or Perkin-Elmer did for us, of course, was to construct the Fine Guidance Sensors on the Hubble Space Telescope, which was a very challenging job, and the entire optical assembly as well as the two mirrors. The bulk of the cost

was associated with the fine guidance sensors, to a lesser extent the optical assembly, and to a lesser extent still the two mirrors.

What has to be always evaluated when you deal with the application of an award fee is if the fee was applied to the Fine Guidance Sensors, then you have to bear in mind that they work beautifully. I mean, they're having a wonderful time with them. Now, having said that, though——

Mr. ROHRABACHER. That's like an automobile that has a very fine transmission system but the engine falls apart.

Dr. FISK. I understand the analogy, but let me return to the first point. My desire not to pursue this here is really not addressed at protecting individuals but protecting the options of the agency to pursue this very vigorously.

Mr. ROHRABACHER. I accept that. So I guess your answer to the second question is in fact that that company is actually being considered for an award fee for the things they did that were correct, even though the overall project was a flawed project.

Dr. FISK. What NASA will do is be both fair and diligent in getting the absolute maximum restoration the Government allowed within the existing contracts.

Mr. ROHRABACHER. Just one note. I think that we can be effective in our role as Congressmen who are supposed to be here making sure that we get the best use out of the taxpayers' dollars if we make sure that people are held accountable, and sometimes that's really not a very pleasant task, because all of us have made mistakes. I mean, I must make at least three or four mistakes a day, but still I can tell you my voters hold me accountable for those mistakes, and we're not going to have any progress in this country unless we get back to the old-fashioned idea of responsibility and accountability, especially in a situation now where we have this budget deficit problem and people are really scrambling for dollars and there are worthy projects that are going unfunded. It's going to be incumbent upon us to really make sure that everyone is held accountable, so I hope you'll understand our position as well.

Dr. FISK. And I agree with it.

Mr. ROHRABACHER. Thank you very much.

Dr. FISK. Thank you.

Mr. HALL. The Chair recognizes Mr. Rhodes.

SCIENTIFIC USE OF SPACE STATION

Mr. RHODES. Returning to the space station for a second, your comment in response to Mr. Rohrabacher was that you believe that a restructured space station is affordable, is buildable, and is productive. I'd like for you to expand on the productive aspect of it, because we all know the Augustine Commission has recommended that space science become NASA's number one priority. Presumably, the space station would be a major component of NASA's application to science and to making science its number one priority with a downsize. Would you just expand a little bit in terms of the ability of the station to produce increases in man's scientific knowledge? Tell us how it's going to work.

Dr. FISK. Okay. Let's remind ourselves of a couple of things here. The space station is applicable to two science programs—microgra-

vity research and materials and fluids in space and life science research. I do not anticipate that there will be extensive use of attached payloads out in the space station, and therefore the station will not play a role in the Physics and Astronomy Program, will not play a role in the Planetary Exploration Program, will not play a major role in earth science observation. But in those two disciplines, materials research and microgravity research and life science research, the station is the infrastructure, the device, the facility to which those fields are working and evolving and plan to base their long term future on.

Now, when we judge the utility of the space station for materials research in space, we have a certain number of things that it has to provide to us. One is that it has to provide power, and the normal criteria for saying this is a usable, useful station to us is that there is substantially more power than is available on a spacelab mission, where we are currently limited. It needs to provide us with a good microgravity level.

In microgravity research, you want to be at 10^{-5}g a millionth of the force of gravity on the face of the Earth, and the extent to which you can get that for long durations, then you have really achieved a usable device for materials research in space. Because, again, spacelab missions are limited to only a few days—10, 12, 16 perhaps—and certain materials experiments that you want to do simply have a longer gestation time than that.

So when we evaluate the space station, we ask will it give us a decent microgravity level, will it give us decent power, and can we have those for a decent duration? From what I have seen of the restructured space station, the answer to those questions is going to be yes.

In the case of the life science research activities, the constraints are more in the direction of being able to have long duration human flight on the space station, because that's after all one of your principal motivations. You want to understand how humans live and work in space in preparation for more ambitious tasks. The extent to which the permanent manning of the station is delayed as a result of the restructuring, of course, is a setback to that kind of life science research. If you don't have humans up there in permanent residence, then there is a limitation.

But, again, the station is intended to be around for 30 years, and if we start a year or two later than we intended to, I don't view that on the grand scale of things as a major setback. So the way we sort of envision this is in the early use of the station there's a heavy emphasis on materials research, because that's the thing you can do best, but in late use of the station there's a heavy emphasis on life science research, because that's really one of the things the station provides very well to us, and both of those are accommodated in the plan to restructure.

Mr. RHODES. Is the anticipated useful life of the station 30 years?

Dr. FISK. That's sort of the kind of number that we always hear, and I put that in the same category as the useful life of Voyager, which was supposed to be four years to get to Saturn, and we got 12 or something like that. I mean, there is no intrinsic limitation so long as you maintain it on orbit.

Mr. RHODES. You placed a great deal of emphasis in your answer on power, and that's a concern to me, because it would seem that over the course of a possible 30-year-plus useful life we'll find other things to do with that station. You also did use the term, I think, "an evolving mission," and certainly I think we would all anticipate that people will think up different things to do on the station over 30 years, and yet the power capability of the station is limited. It's finite. That's been a concern of mine that we are limiting the ability to evolve the mission of the station, because we are limiting the capability of the station itself to generate power. Can you talk to us a little bit about that?

Dr. FISK. Well, I don't pretend to be an expert on power systems, but let me put it on a more philosophical or conceptual basis. I think the thing that we should do first with the station is drive hard to get it in orbit. Here is a program which nominally started in 1984. We're sitting here in 1991, seven years later, and it doesn't exist. So the time has come to freeze an early design of this station and drive hard to have something physically on orbit.

Now, I think then the second conceptual issue that you have to say is, "Is there anything that I'm doing to this station which absolutely precludes an evolution over the multi-decades that I would expect to do it?" I mean, would I have to start completely over? Now, I'm hardly an expert on the inner workings of the space station, but I'm not aware of such things. Now, that doesn't mean to say that there is a plan or a budget or whatever that says I'm going to have a different kind of power system in the year 2010 or 2020, but I think the main thing is to press hard on the front end of this and then just be aware that the facility will be there, the facility can be modified over its many years in operation and undoubtedly will change both in terms of its mission and its power, et cetera, over that period of time.

Mr. RHODES. Well, Dr. Fisk, just to, I guess, close the loop for the record on this issue, it's our understanding that the restructure plans for the space station rely solely on one source of power, that the designers have totally rejected the possibility of using solar dynamic power in initial planning or even in add-on planning. In other words, it is our understanding—and I would stand to be corrected—that the one knowable capability of increasing the power output of the station in the future, solar dynamic, has been written out not only of initial planning and design but of future planning and design—in other words, as a possible future addition. It seems to me that in our rush to get into orbit—and I happen to agree with you that we should get the thing up—but in our rush to get into orbit, it would be a tragedy for us to put something up that is limited in its ability to be adapted 10 or 15 or 20 years from now to meet an evolving mission, and I'm afraid that's what we're doing.

Mr. HALL. Thank you very much.

I guess we'll recognize Mr. Bacchus. I think you have a very timely question. We'll recognize you at this point.

Mr. BACCHUS. Thank you, Mr. Chairman.

Can you hear me? We were in another subcommittee the other day of this committee talking about the advances in high technology. Unfortunately, we couldn't get the microphones to work. [Laughter.]

SHUTTLE LAUNCH SCHEDULE

Dr. Fisk, I'm Jim Bacchus from central Florida, the 11th Congressional District. The Kennedy Space Center is in my district, so I'm doubly interested in your work and your progress. Doctor, I understand we've just heard that the problem with the door hinges on the Discovery has caused NASA to decide to roll Discovery back away from the launch. How will this affect the scheduled launch of the Gamma Ray Observatory? How will it affect the program that we have or the schedule that we have in terms of manifests for launching scientific payloads the rest of this year?

Dr. FISK. First of all, on the roll-back decision, you actually know something I don't know, because they were meeting last night on this issue, and I have been running around this morning without being in my office, so if that is the announcement, it's one I know there was a major decision meeting being taken.

Mr. BACCHUS. I appreciate that, sir, and I apologize for catching you unaware.

Dr. FISK. That's all right. Now, as for Gamma Ray Observatory, fortunately, that should not be affected by the roll-back decision, because it is a separate orbiter, and there is no evidence of the issue in the hinges on that orbiter.

Mr. BACCHUS. Gamma Ray will be on the Atlantis. Is that correct?

Dr. FISK. That's correct. But to answer your second question, if there is a roll-back decision, that obviously has a major impact on the downstream manifests, because we had three launches scheduled for Discovery this year—the DOD mission now, the TDRSS mission in the summer, and the UARS mission in the fall—and that will require some rejuggling in order to execute those missions. There are some hard constraints there.

UARS is a mission which doesn't have a launch window in the sense of a planetary mission, but it has a seasonal window. You want it to have several winters. It is a mission which uses cryogenic equipment, and therefore it has a limited lifetime, and you want to time it so that you get two winters. So that will require quite a struggle for us to both get it off or to cause it to be delayed, if that is the outcome.

But I'm sure that those are manifest decisions that are now—we take these things sequentially, we figure out how safely to fly the next mission and always err on the side of safety, and then we figure out how to deal with the consequences that result from those decisions.

Mr. BACCHUS. What are your thoughts on the potential severity of this problem with the hinges and the cracks?

Dr. FISK. I'm afraid I'm the wrong person to ask. I'm sorry, sir, I really don't know. When I last understood this problem, the issue was not so much in trying to understand the potential consequences of it, but the issue was to try and understand where they came from in the first place.

See, one of the puzzles is whenever you do an analysis and you say, "Well, look, I think this is not going to be an issue," then you have to say, "Well, what was in fact the cause of this?" If I want to

believe my analysis, I'd also like to believe that I know where the cracks came from in the first place.

Mr. BACCHUS. As I understand it, they at least have tentatively concluded that we're talking about metal fatigue.

Dr. FISK. Again, I think you and I have the same source of information. Whether it's an accurate one or not, I'm not sure.

UARS UPPER ATMOSPHERE RESEARCH SATELLITE

Mr. BACCHUS. What about UARS? How does it relate to the EOS proposal, if at all?

Dr. FISK. Very closely. The Mission to Planet Earth is an evolving program. There are a series of missions, in fact a very large number, well in excess of 20-some-odd missions, that will fly over the next few years and each give information about the global environment. In the case of UARS, it is the upper atmosphere, so you're dealing with the ozone depletion problem primarily. In the case of the European Research Satellite, which will be launched this May, you're dealing with oceans and ice. TOPEX/POSEIDON, which goes in 1992, a NASA/French mission, deals with ocean circulation. So each of these missions will take a major bite out of one of the important problems in global change.

Mr. BACCHUS. If we delay UARS, are we also delaying our time table for implementing EOS?

Dr. FISK. Not our time table for implementing, but our time table for producing early results.

Mr. BACCHUS. We could send the satellites up, we just wouldn't be able to produce the information.

Dr. FISK. We would not see—if UARS were to be delayed, then information on ozone depletion would similarly be delayed. In the case of EOS, for example, there's an instrument we'll fly on it called Hirdls, which is an upper atmospheric sensor. It is the follow-on instrument to the UARS. Now, UARS has a limited lifetime, so a delay of the time of UARS would not limit when we would fly EOS, because there's still a gap between UARS and EOS as it is now, but we'd delay the information. The information and the understanding would be delayed.

Mr. BACCHUS. You said there were three missions we were planning this year for Discovery. UARS was one in November, I guess, a DOD mission, and what was the third?

Dr. FISK. TDRSS. Tracking and Data Relay Satellite System.

Mr. HALL. Would the gentleman yield?

Mr. BACCHUS. Yes, of course.

Mr. HALL. All three of those missions would be by Discovery, one set in July, as I understand it—I'm asking, I'm not testifying—that has to do with data relay and seemingly not as important as the one in November for atmospheric research that would lead to, I think, more achievement maybe than the July mission. Is there any way of substituting those or of delaying or replacing or switching places with those if you have to use the same shuttle? And is that being considered?

Dr. FISK. That and other options are being considered, I can assure you. I mean, as always with these cases, the first order look always has to give way to the second order look on these things,

because you have to ask questions of, for example, does UARS depend on that TDRSS being up? These are, after all, the satellites which track UARS. You have to ask whether or not the orbiter can be made compatible. UARS has some cryogenics in it. Will the mods to the orbiter be ready in time?

I mean, there is a whole series of second order questions that one asks when they do it, but I can assure you we will press on this issue, and the science organization is going to be vocal in the extreme here in getting its missions off, particularly UARS.

Mr. BACCHUS. Thank you, Dr. Fisk.

Mr. HALL. The Chair recognizes Mr. Zimmer.

Mr. ZIMMER. Thank you.

INCORPORATING LANDSAT DATA INTO EOSDIS

The President, in his 1992 budget, stated, "Acquisition of data from land remote sensing satellites is an important element in understanding global change." What are your plans for incorporating data from LANDSAT into the Earth Observing System Data and Information System (EOSDIS), as recommended by the National Research Council? That is, archived data and current data.

Dr. FISK. There are two aspects of that problem. As you know, one of the principal difficulties the research community has with LANDSAT data is the expense of the data, which is sold at commercial rates, so to the extent that that's an unsolved problem—I mean, that still remains an issue for being able to adequately incorporate all that data into the EOSDIS. Now, fortunately, recently the EOSAT released a large block of data from the MSS—multispectral scanner—that was valid as of two years ago. In other words, it was an historical archive data set, and we are moving out briskly to make that data set part of the early data sets that will be available on the EOSDIS.

You may recall that the plans on the EOSDIS are to have an evolving system which starts with our taking existing data sets and making them usable to the science community. They are called pathfinder data sets, and we have a whole series of this, and the MSS data will be incorporated into those pathfinder data sets.

I think we still have the recurring problem that says, "Is LAND SAT data being continuously collected these days?" The answer is no. "Is the data that's available from LANDSATs affordable in being able to routinely incorporate this into the EOSDIS system, except for these sort of end block releases of archival data?" That's an unsolved problem as well.

Mr. ZIMMER. There are two concepts here. One is the cost to you, and the other is the expense of generating the data. It seems to me since you're talking about a Government-sponsored operation with LANDSAT that you're imposing arbitrary barriers between the generator of the data and the users of the data.

Dr. FISK. LANDSAT is not now a Government-operated facility. It is the——

Mr. ZIMMER. Well, it's Government-subsidized in a very heavy way.

Dr. FISK. Except that under the LANDSAT Act, which I've forgotten the date of it—you know, this transferred first of all from

NASA to NOAA and then from NOAA to the private sector in the presence of the EOSAT Corporation, and we the Government do not control the price of the data.

Mr. ZIMMER. But the Government does provide for the launch of the vehicle, correct? Of the satellite?

Dr. FISK. This is a NOAA issue, and I——

Mr. ZIMMER. Okay. Well, NOAA is part of the Government, right?

Dr. FISK. Sometimes. [Laughter.]

Mr. ZIMMER. It seems to me there are certain economic factors here, but there are also some institutional and political problems, as I see them, and what I'd like to know is whether in fact the cost of gathering and disseminating the information is prohibitive or just simply the amount that would come out of the NASA budget for getting this information is prohibitive.

Dr. FISK. The answer is yes and yes. The normal way in which the rates of LANDSAT data are set is for the commercial market, which is primarily interested in very high-resolution, small seams. I mean, if you're a water district and you want to have a picture of your water district, you only need to know a piece of that and with a considerable resolution. The people that are interested in global change studies, researchers, which is our involvement in the program, are interested in very broad coverage.

You know, there's a simple little calculation you can do which is revealing only in its extreme, but if you said, "If I took the current rates for LANDSAT high-resolution data and I asked them to generate a picture of the Earth"—after all, EOS will routinely measure the Earth, for example, or other satellites will—"give me the whole image of the entire Earth, what would it cost at commercial rates?" The answer is like $50 million for one image. Now, clearly if I went to EOSAT and said, "I'll give you a bargain, I'll only pay $100,000 for this image," I'm sure they would probably be happy to oblige. But it illustrates the point that the routine coverage on a global basis which is necessary for global change research cannot in fact be afforded at the kinds of rates for which the data are normally being set at commercial rates.

So it is a combination of a rate structure which is not conducive to global change studies and, as a result, inconceivably inadequate funding in the research budgets of not only NASA but the National Science Foundation and all the other people who would be interested in this to be able to pay for that data.

Mr. ZIMMER. Then how would you propose that the Government as a whole and NASA specifically fulfill the President's commitment to ensure the continued availability of LANDSAT type data, particularly for the global climate studies?

Dr. FISK. Well, this is a problem which I—let me put it in a slightly different way. It's not my position in the Government to set policy on other agencies and other institutions, and so I think what we have to look for there is a policy decision by the Government as to how they want to pursue that, and as we would say in NASA, that's above my pay grade. My job, I think, here is simply to tell you that from the point of view of global change researchers, which I do represent, there is a resource in LANDSAT data which is not being adequately incorporated into the global change studies.

Mr. ZIMMER. Well, is there anybody above your pay grade who is working on the problem? Because it seems to be a problem that's susceptible to resolution. It's an institutional problem rather than a scientific one.

Dr. FISK. I think that's a fitting discussion for the Committee on Earth and Environmental Sciences, which coordinates global change studies across the Government, and the President's science advisor, to whom the committee reports.

Mr. ZIMMER. I guess I'll ask them.

Dr. FISK. Thank you.

COOPERATION WITH SOVIET UNION IN LIFE SCIENCES

Mr. ZIMMER. Just to get back to the life sciences issue with respect to the space station, have you given any consideration to having United States astronauts conduct life science experiments on the Soviet space station in preparation for designing and developing the life sciences portion of our space station?

Dr. FISK. That concept off and on does get some discussion. There is actually an even more straightforward way to do that, and that is being done. The Soviets, of course, do fly routinely. They share data with us very openly on life science research, and we have in fact provided to them routine medical equipment in some cases, the kind of equipment that is available on the open market—these are not high technology issues, just routinely available in the United States, which is better than the equipment that the Soviets use—and so we've provided some equipment in return for some very detailed data.

So what we're finding is that this is the ultimate leverage—their Cosmonauts are in effect the subjects, and we are the recipients of important data to us that is being incorporated into our Life Science Program.

Mr. ZIMMER. So you don't think that there would be a benefit to having the United States astronauts actually conduct experiments in the Soviet space station?

Dr. FISK. It's certainly something that's worth talking about, but I think you have to remember that when you do life science research, the important thing is the sample size, how many different human beings can we get data on, because you really want to create an operational capability. You don't want this to be unique to one astronaut. You want to have a routine operational capability for all astronauts.

So although it would be useful to perhaps conduct some experiments with American astronauts on the Soviet space station, it would be such a limited event compared to our being able to monitor and get data on a whole series of Cosmonauts. That's actually a more useful scientific adventure for us.

Mr. ZIMMER. Do we have any kind of input other than just selling the equipment into the Soviet experiments?

Dr. FISK. Oh, yes. This is a cooperative effort. There's a series of working groups that occur routinely to discuss the data and the meaning of it, et cetera.

Mr. ZIMMER. How is what we know going to influence what we do in our space station?

Dr. FISK. Well, the issue that we continue to face is how do you produce adequate countermeasures in order to make people productive over extended periods in space, and you end up dealing with some very basic biological functions of the human body which are not well understood in this—you know, how your gravitational receptors work, what is the calcium deprivation that occurs in the body, et cetera—and we're in a very basic science mode here of saying, "Let me begin to understand the human body at the cellular level, the enzyme level, you know, the very basic level, and then as a result of that produce the appropriate countermeasures that will extend the presence not just for a month or two but for half a year and a year and not just have them survive but be able to land, to work, to be able to readjust to gravity as a minimum." And so the way I view this is as part of a very basic research activity on how humans work in space.

Mr. ZIMMER. Has the quality of the data that we've gotten from the Soviet Cosmonauts been adequate by U.S. standards to achieve those objectives?

Dr. FISK. It is becoming increasingly so. They've been very open, they've been very good about sharing their data, and now that this is much more of a cooperative project involving front line equipment, the quality of the data is improving.

Mr. ZIMMER. Thank you.

Thank you, Mr. Chairman.

LANDSAT

Mr. HALL. I think the gentleman from New Jersey has opened some very good questions there that probably some of us are going to want to follow up on, particularly the LANDSAT inquiry, whether or not it's a threat to EOS, whether you consider it such. We're using it, it gives us information, and as was pointed out, it's not a NASA program, but you buy data from them—and I'm just thinking out loud—EOS is very expensive and, I think, probably risky from the standpoint of not just technology—there's going to be a lot of trial and error—but Mr. Rohrabacher pointed out the cost and our duties here. It's certainly a budget risk. It's $30 billion, and we don't really realize too much out of it for 10 years. There's just a slight possibility that none of us will be here 10 years from now to see that what we launched did come back to us.

Dr. FISK. It depends on your redistricting, I assume.

Mr. HALL. Right.

Dr. FISK. Permit me, if I can, to jump in on a couple of points there, because I don't want any misconceptions on this thing. First of all, the very fundamental point—we don't have to wait 10 years for information from EOS. The number of projects——

Mr. HALL. What real results will we get back before the expiration of the 10 years?

Dr. FISK. You will see in this whole series of spacecraft that are to be launched—just to give you a measure of this, I did a calculation the other day of how much the world will invest in spacecraft studying the Earth that will fly prior to the launch of the first EOS platform. It's a measure of the activity. The number is like $8 billion. And that's internationally.

The Europeans, the Japanese, the Americans, the Defense Department, NOAA, all of these people making measurements that are going to be made on the Earth. The thing that ties this together is the EOS Data and Information System, which starts now. That's a system that's being developed now, will produce results in the 1993–1994 time frame, which is only two years from now, and continually evolve to an ever more comprehensive data system as we go through the process.

And then you say, "Well, all right, what does EOS bring to this thing? I just spent $8 billion, I launched 20 spacecraft, I studied the oceans, I studied the ice." Yesterday, for example, we signed a Memorandum of Understanding with the Canadians, who are launching something called RADARSAT, which is intended to study ice, and we in turn are going to launch it for them, they're going to build it, and we get the data back as well as they get the data.

These projects will all fly to study various aspects of the system. What EOS brings to this is literally the next generation of that, because in each case there is a limitation in the sensitivity or the resolution of those instruments that will fly in the next seven or eight years that you know is going to limit you in being able to make the next step in being able to understand the earth, and that's a natural evolution that occurs in all science. I mean, Hubble has more sensitivity than the orbiting astronomical observatories did, and AXAF has more sensitivity than did the observatories before it. EOS is the natural evolution from these many missions that will fly into the next generation of sensitivity.

So there are sort of two points there. One is you don't have to wait for EOS to fly to get these measurements, because in each case there are measurements being made in advance, and you can't stop with these first measurements, because EOS is the next generation of resolution and sensitivity.

Mr. HALL. Congressman Geren is recognized.

Mr. GEREN. Thank you, Mr. Chairman. I have no questions.

Mr. HALL. Mr. Stallings.

ORBITING SOLAR LABORATORY

Mr. STALLINGS. Dr. Fisk, could you please discuss your plans for the Orbiting Solar Laboratory?

Dr. FISK. The Orbiting Solar Laboratory is part of the OSSA strategic plan. It is our highest priority new start. It would have been our highest priority new start in 1992 had we been able to get one. It will be our highest priority new start in 1993 if we have an opportunity at that time.

It would be a Phase B study. We are currently discussing with the appropriations side of the Congress limitations on the execution of that Phase B study, but we would plan to proceed with that at some point and then just wait for the budget environment to allow us to proceed with the mission.

Mr. STALLINGS Thank you, Mr. Chairman.

Mr. HALL. The Chair recognizes Mr. Perkins.

Mr. PERKINS. I'll pass. Thank you.

Mr. HALL. Thank you, Mr. Perkins.

The Chair recognizes Mr. Packard.

Mr. PACKARD. I came a little bit late, and I thought you'd be taking some of the others first.

Mr. HALL. We can give you some more time. I can ask questions if you want to——

Mr. PACKARD. No, let me ask one question. That's all I have.

It's nice to see you again, Dr. Fisk.

Dr. FISK. It's good to see you.

EFFECT OF SPACE STATION RESTRUCTURING ON RESEARCH CAPABILITY

Mr. PACKARD. I assume that the downsizing and the changing of the scope of the space station is on track and probably going to move forward, and I presume also that we have met with and worked out international complications that could result from that downsizing. I'd be interested in knowing, however, from your point of view, what changes are anticipated in the downsizing and design changes, and what changes will that make in the basic research that the station will be doing in space when it's completed and operational?

Dr. FISK. Let me answer a couple things that you commented there. From what I have seen so far, I believe this downscoping exercise—restructuring, which is the euphemism that is used—has closely involved the international partners, and they have been an integral part of the activity and I think are very comfortable with what is happening there.

Now, as for the utilization of this thing, the principal requirements that we place on it are an opportunity to do materials research, an opportunity to do life science research. In the case of the materials research, we look for power, low microgravity levels for a reasonable duration, and in the case of life science research, we look primarily for long duration human presence. The station will be able to achieve all of those requirements.

There probably would be a delay in the permanent manned capability and therefore in the life science research done involving that longer than the original design, and that's schedule and cost and budget driven. But if you stand back and look at this station over the decades that it is supposed to be there, all its goals will be achieved from the user standpoint.

Mr. PACKARD. So you anticipate that even with the redesign it will accomplish all that you had hoped and planned for it to do in terms of science research?

Dr. FISK. That's right. The one thing that we will not get and I'm not unduly disturbed by is we will not do a lot of attached payloads early on in this, if any, and in many ways I think that's appropriate. The principal use of the station, the unique thing that it brings, is laboratory sciences—material science and life science research. Attached payloads, for the most part, can just as easily be done on free-flyers, and we will accomplish those in some other way in the program.

Mr. PACKARD. Will changing of the crew size alter the research and the science and the work that's going to be done?

Dr. FISK. In the early station, it is not. The station will be smaller, as you know by the restructuring, and therefore have a smaller

crew. You really have to ask from a science point of view how many payloads does an individual crew member have to take care of? You don't want the sort of one-armed wallpaper hanger problem where you have one crew member taking care of too many racks. The station's downsizing undoubtedly will be compatible with the size of the crew.

In the very long term, when you deal with life science research and permanent manned, the only difficulty you get from a limited crew is how long it takes you to build statistics. If you want to study many different subjects in orbit for a long period of time and you only have half the crew, it takes you twice as long.

Mr. PACKARD. On the other side of the coin, is there a plan to increase its capability in any area to provide you with some kind of opportunity that we did not have in the first redesign?

Dr. FISK. The area that we have pressed for and I expect to be adequately accommodated is, during the early use of the station during the man-tended mode, we did not deal with the use of station between shuttle flights in previous exercises on the station, yet from the microgravity point of view, that's an ideal time. Put the experiment up, get it going as you leave, close the door behind you, and then let the station run very quietly and very low gravity until you come back on your next shuttle flight.

We have been working hard with the station to see that that kind of science can be accommodated in the restructured station, and the microgravity users are very excited about that as an opportunity.

Mr. PACKARD. Thank you.

Thank you very much, Mr. Chairman.

DISCOVERY ROLLBACK

Mr. HALL. Let me just make an observation. Just assume that NASA has decided to have to roll the Discovery space shuttle back to the assembly building to repair a broken door or hinge or whatever it is, and assume it would take about a two-month delay and further that they've decided that the other two orbiters, Columbia and Atlantis, are also having some symptoms of the same door hinge problems. I'm not sure that's true, but I've heard that it is true. If it's decided that they need to be repaired now, too, this would certainly affect the Gamma Ray Observatory launch that's scheduled for April 4, would it not?

Dr. FISK. I am told that there's a press conference at 11:00 to announce the decision on 103 (Space Shuttle Orbiter Columbia), so two minutes from now we'll all know.

Mr. HALL. We'll know two minutes ahead of everybody else if you'll tell us. [Laughter.]

Dr. FISK. Let me just state that I was impressed by the accuracy of the early information I heard just a few moments ago.

To my knowledge, and I may not be current as of this morning, Atlantis is not an issue here on the doors, and therefore that would not affect the GRO launch. If that data is not accurate and it is an issue, yes, obviously it would affect it. Remember, we have two pads, two streams of processing, so the processing on the GRO and its orbiter and Atlantis and the Discovery mission are really sepa-

rate from each other, and so only if the doors were implicated would there be an implication for the launch.

Mr. HALL. I've heard that they are implicated. Is that just a rumor? Is that true that Columbia and Atlantis are having the same symptoms? You probably have the same product?

Dr. FISK. You have me at a loss. To the best of my knowledge and the people around me, Atlantis is not implicated.

Mr. HALL. Okay. Before I turn Mr. Nagle loose on you, let me ask you one thing here. We have him leashed over here and ready to go.

Mr. NAGLE. I'll be a nice guy today. [Laughter.]

AXAF MIRROR DEVELOPMENT

Mr. HALL. The Advanced X-Ray Astrophysics Facility—let me ask you about that and the problems that they're having with this mirror development. I'm not going to ask you to go into the nature of the problem or how close you are to solving it or even how much of the fiscal year 1992 request is for mirror development, but what would be the impact, for example, on the program if the money for spacecraft development was withheld until the mirror problem is satisfactorily resolved? What would that do to you? And that's a possibility.

Dr. FISK. That would slow it down. We made an arrangement back in 1989 when this was a new start that in the spring of this year we would demonstrate that we could build the largest mirror for AXAF at the half arc second resolution, and let me give you 30 seconds on this. I won't get too technical. The polishing is going very well, better than expected. The real challenge to this thing is to measure the mirror to the extreme accuracy that is required between polishing cycles so you can tell the polisher what to do next. It's state-of-the-art.

We're looking to make measurements where—I mean, we discovered, for example, that a fan in the other side of the building created enough acoustic disturbance that it caused a little wiggle in this thing. So we're working those issues off one by one, but as of today we expect to meet the Congressional milestone of having this thing polished by this spring.

CONCERN WITH DELAY IN DATA RETURN

Mr. HALL. Let me ask you this. In the Augustine Committee's report, like the Rockefeller Committee, who is the successor to the Pepper Committee on health care for us old folks, it laid out everything but how to pay for it. I think that's the major reason that they formed the commission, but we didn't get any answers after about a 5½ month study from that.

A concern of a lot of people in the space science community is that the time between the project conception and the return of scientific data has become too long, an unacceptable length of time, and the risk of losing the funds in the interim is too high, especially for university-based research. The Augustine Committee's report alludes to this problem, but they don't really offer a solution. What are your suggestions on that?

Dr. FISK. I think you need to divide the problem up a bit here. Major flight missions—AXAFs, GROs, Hubbles, EOS—by necessity take a fairly long time to build. Six or seven years is about what it takes. Then if the funding profile isn't met or there's some technical issue or the launch slips, you know, the thing can stretch out. But those missions are essential to really making breakthroughs in science, and so you do them.

But what you've got to do in addition to that is add to the program the small missions which can be built on the scale of two or three years, four years maximum, where you're willing to take some risks because they're not as visible as the large programs and which have a strong university participation in because they're now on the time scales where graduate students can get involved.

We've been trying to do that. We augmented the Explorer Program back in 1990 to add the SMEX Program—small explorers—Earth Probes give you some of that, and there is more that ought to be done.

Mr. HALL. Isn't it a fact that the Explorer Program was really intended to be a small, fairly frequent program, but each mission has become more costly?

Dr. FISK. What happened there was sort of an evolution in science. The simple measurements were starting to be made, and people kept dreaming up bigger things to do, and we've tried to drive it back the other direction by adding these small explorers, of which there are three under construction at the moment and more to be chosen, which are in the sort of $30 million per spacecraft range, and that's a very small cost.

Mr. HALL. If we have time, I want to get back to some things with you that you covered in your very kind letter to me of February 26. Somewhere it was said, "Oh, that mine enemy would write me a letter." Oh, that my friend has written me a letter, I want to ask you some things about it, and you know what I'm interested in and what your letter covered. It's the use of the Russian space station and the likelihood of it.

I recognize Mr. Nagle at this time.

Mr. NAGLE. Good morning. What did they do, turn off my microphone? Is that the new Chairman's method of curtailing me?

Mr. HALL. No, we're getting you right up close to the time of a vote here. [Laughter.]

Mr. NAGLE. I'll be brief. I'm not even mad at anybody this morning. Glad you're here. Nice to see you. Just a few questions.

Mr. HALL. That's what you told Admiral Truly. [Laughter.]

SIZE OF SPACE STATION CREW

Mr. NAGLE. As I understand it, the space station crew has been reduced from eight to four.

Dr. FISK. The restructuring station is still going on, but I think you can assume that in a smaller station there will be a smaller crew.

Mr. NAGLE. In your experience, as I understand it, the current plan—I know this is subject to change—the current plan is that we'll have 32 double racks?

Dr. FISK. Current being pre-construction?

Mr. NAGLE. Pre-redesign.

Dr. FISK. I would have said it's 44 offhand.

Mr. NAGLE. Forty-four. Okay. In your experience, how many double racks can a single astronaut handle?

Dr. FISK. Well, let's see if we can work this out. I think the principal involvement of the astronauts is in start-up. I would guess five or six without thinking about it too hard.

Mr. NAGLE. I think you're four to five over what I was told, which is that the single astronaut can handle about one double rack. But all right, five or six. Now, if I understand the new crew structure, you're going to have four crew members—two to fly and two to do science. Is that correct?

Dr. FISK. Again, within the limits of the restructuring, I think that's a reasonable assumption.

Mr. NAGLE. All right. Then why are we going to have three labs?

Dr. FISK. Well, again, you know, count racks. [Laughter.]

Mr. NAGLE. Labs, not racks. We've got three labs, if I understand it, under the restructure—ours, the European, and the Japanese.

Dr. FISK. That's always been the case, but I think what you're going to find is that the volume of the labs, particularly the United States lab, will be substantially smaller, and so if you ask the question, "How many racks can an astronaut rack?" [Laughter.]

Mr. NAGLE. I'm still in labs, though, because we get two to fly and maintain the thing, so we're going to take two scientists to work in the labs, and we have three labs. Which country doesn't get to use its lab on which flight?

Dr. FISK. Now, wait. You're asking two questions there.

Mr. NAGLE. Yes, I'm on labs. You want to talk about racks.

Dr. FISK. Don't forget when you fly up on utilization flights of the station, which is prior to permanently manning it, then you're not limited to just a four-man crew. I mean, we normally fly seven astronauts on the shuttle, so you could imagine you had two pilots and five astronauts to take care of that.

Now, if you say, "When I go to permanently manned, how many astronauts do I have?" then presumably I've got to say four with two there. If you work out the numbers and say, "Which gives more to the science—four astronauts there with two doing science permanently versus seven visiting occasionally during the course of the year?" the four there permanently always wins.

I mean, even if they turned off some of the racks on Tuesdays and Thursdays because they couldn't keep track of them, but they're there all the time every day being able to do that research, and you've got plenty of crew to go around.

Mr. NAGLE. Well, a couple of questions on this. Are you satisfied that on the space station—I support the space station, I don't want to be misunderstood on that—are you satisfied that we're getting the balance there between manpower availability and the number of science projects that we're supposed to be doing? In other words, can we utilize everything that we're putting up there, given the reduction in crew sizes?

Dr. FISK. Yes. In fact, I'm more satisfied with the discussions in the restructuring than I was in the original station. If you ask yourself sort of how many racks do you need, you've got two disciplines doing microgravity, doing life science research, you can

count them up, and we have pieces of equipment under way, and they would accommodate very nicely in a smaller station. The balance is better between the number of racks, the power that's available, and the number of crew members in the smaller station than it was in the very large station.

Mr. NAGLE. Is there an internal NASA report dealing with this issue? Because I'm told that there is.

Dr. FISK. Well, perhaps you know one I don't know. I mean, the structure that we have is a series of advisory committees that advise us, academy committees, internal NASA committees feeding into my office, which represents the users, feeding into space station saying what in fact our requirements are, and those various committees, of course, put out statements and position papers, but I'm not sure I understand any particular report other than the volumes that we have on this issue.

Mr. NAGLE. This area of manpower availability versus science capacity and the ratio between the two has not been subject, you're telling us, to any internal review or discussion by NASA?

Dr. FISK. No, you missed my point. It's subject to continuous review. I can't think of a specific report that outlines the multitude of discussions that go on on that.

Mr. NAGLE. And they're not subject to any kind of an inter-NASA report or review beyond simply the involvement or the purview of your agency but involving also other branches of the NASA organization?

Dr. FISK. Well, but again, there are five external advisory committees that advise us on the space station. In fact, they are meeting today. The Space Station Science Users Advisory Committee—whatever the acronym is—is meeting in Florida as we speak looking at the utilization of the space station, the Space Studies Board is meeting in California these days looking at the utilization of the space station, so that's an ongoing review activity that continually occurs.

Mr. NAGLE. I regret that I have to pursue this as precisely as I am, but I once asked one of your predecessors at NASA if he knew of any reports dealing with the safety aspects of the orbiter, and he denied that any such reports existed, and that was at the time when the ASAP report was just out, and he said he didn't understand. So I want to be understood and I want you to understand that if there is internal review on this question, I would be interested in seeing a copy of that report and the committee would be so that we can resolve this question.

In the old design, you had a crew of eight, six doing science. How many racks did you have in the old design?

Dr. FISK. Seventy-one.

Mr. NAGLE. Now we've got a crew of four, two to do science, and we've got 44?

Dr. FISK. No, 15 in the U.S. lab and 28 or so in the internationals when they come up, so you're talking 40, I guess. I mean, if you want to worry about it, we've got half the number of racks and a third the number of crew.

Mr. NAGLE. That's what I was trying to——

Dr. FISK. But I'm not excited about it, either. I mean, I'm not particularly worried about it.

Mr. NAGLE. Okay. You know, we're looking at this thing from the standpoint of trying to put as much up there as we can, but obviously we don't want to put things up there that aren't going to be utilized. I mean, we've got enough cost pressure on us in this place anyway. I just want to make sure that in fact we're not building something that we can't utilize because of the decision to downsize the crew. But you're comfortable in telling me, Dr. Fisk, that that's not in your capacity with NASA and a concern of yours. Is it a concern of our European allies or our Japanese?

Dr. FISK. I think the only thing that might be a concern to them is if you have a limited number of crew, you may have a limited number of opportunities to fly nationals from those countries. I don't think it's a science issue as much as perhaps that being a concern to them.

Let me just make a general statement. In the process of restructuring the space station, the OSSA position and the user position has been consistently that it is quality not quantity that counts for us. We want the quality of what we can do in the way of research. Power available, microgravity level, data rates—those things need to be protected for us as opposed to the number of racks we have on the space station.

Mr. NAGLE. Last question. I appreciate your answers. Have there been any discussions of this problem of downsizing crew and science availability with our international partners?

Dr. FISK. I'm not sure I can give you specific examples. There are two interfaces that occur here. I mean, the space station, in answer to a previous question, as part of the process of restructuring, has had extensive dialogue with the international partners, and that goes on through space station, through level two, et cetera.

On the users side, there is a series of joint user bodies that meets—IFUSS, which is the International Forum for the Use of Space Station or something like that—which meets on a regular basis and discusses these issues.

Mr. NAGLE. Thank you.

Thank you, Mr. Chairman.

That wasn't so bad, was it?

Dr. FISK. You're not up to your usual form. [Laughter.]

Mr. HALL. The Chair recognizes the former chairman of this subcommittee, Mr. Volkmer.

PROGRESS OF SMALLER PROJECTS

Mr. VOLKMER. Dr. Fisk, I'm sorry I wasn't here earlier to listen to your testimony. I've tried to review parts of it, and it appears, as far as I can see, that the scientific experiments as far as what I call large experiments that we started on years ago and are continuing are on a sound basis right now and moving right along. This may have been addressed earlier, but I'd like to delve into it a little bit. How much is that impacting on our total scientific effort, the large-small problem, if you understand what I'm getting at? Are we having sufficient funds left over to do the small—I can't find it in your testimony where you address that except that we had, I think, 30 sub-orbital rocket flights and 25 balloon flights, and I don't find much else said.

Dr. FISK. That's a weakness in my testimony. We tend to worry about this same issue, and the ratio of small to medium to large, which is how we normally do this, large being an AXAF, an EOS——

Mr. VOLKMER. Hubble Telescope.

Dr. FISK [continuing]. Hubble Telescope, and then there's sort of a medium category where we have some things at the $500 million level—the Mars Observer, for example, TOPEX, things like that—and then the small missions, which are the Small Explorers, the Earth Probes, and I think you also have to count—you know, Hubble is an interesting case. Do you count a replacement instrument on Hubble as a small project or is it a large project? I mean, after all, it's a $70 million or $100 million maximum replacement instrument being built by a university. So does that make it a small mission? I think in some sense it does, because I'm not sure if there's any difference between bolting that instrument on the Hubble Space Telescope versus bolting it on the top of a rocket or taking it to a space station or something like that.

But in any event, if you do the calculation, I think, fairly, we find that the ratio in sort of the present budget is, you know, the large is running about 20 percent of our budget, 25 percent maximum, and it will grow a little bit as EOS projects grow, but the mediums and the smalls and the payloads and so, make up an equal share of the funding budget, and we try to preserve that balance. I think we always have to be conscious of the fact that the big ones get all the noise, so the impression is that that's all there is in the budget, but in fact if you look at the payloads for spacelab and space station, you look for the Explorer Program, and you look at these medium size things, they're holding their own in the budget.

Mr. VOLKMER. All right. And I'd ask you to furnish me with a breakdown as to the amount of——

Dr. FISK. I'd be happy to give you this sheet.

Mr. VOLKMER. Now, wait a minute. You haven't heard the whole question.

Dr. FISK. Sorry.

Mr. VOLKMER. Not just this year. Say go back four years. I don't want the large ones. I want to know where the small ones are in there and how much we have, whether we're losing ground, staying level, where we are. I'd like to have that.

Dr. FISK. Okay. Will do.

[The information follows:]

OFFICE OF SPACE SCIENCE AND APPLICATIONS FLIGHT PROGRAMS ($M)

	FY87	FY88	FY89	FY90	FY91	FY87-91
Major Projects	96	93	121	156	401	867
Moderate/Small Projects	766	831	1006	989	1029	4621
Mission Ops. & Data Analysis	240	229	271	396	523	1659
Research & Analysis	453	447	460	512	540	2412
TOTAL	1555	1600	1858	2053	2493	9559

	FY87	FY88	FY89	FY90	FY91	FY87-91
Major Projects	6%	6%	7%	8%	16%	9%
Moderate/Small Projects	49%	52%	54%	48%	41%	48%
Mission Ops. & Data Analysis	15%	14%	15%	19%	21%	17%
Research & Analysis	29%	28%	25%	25%	22%	25%
TOTAL	100%	100%	100%	100%	100%	100%

NOTE: Figures may not add due to rounding

The Major Projects category includes programs where the total development cost per spacecraft exceeds $700 million. The programs included in this category are: Advanced X-ray Astrophysics Facility (AXAF), Comet Rendezvous Asteroid Flyby (CRAF)/Cassini, Earth Observing System (EOS), and Hubble Space Telescope (HST).

The Moderate Projects category includes programs where the total development cost per spacecraft is between $200 million and $700 million. The Small Projects category includes programs where the total development cost per spacecraft is less than $200 million. The programs included in the Moderate/Small categories are: Advanced Communications Technology Satellite (ACTS), Astro-1, Atmospheric Laboratory for Applications and Science (ATLAS), Combined Release and Radiation Effects Satellite (CRRES), Cosmic Background Explorer (COBE), COSMOS Program, Earth Probes, Explorers, Galileo, Gamma Ray Observatory (GRO), International Microgravity Laboratory (IML), International Solar-Terrestrial Program (ISTP), Magellan, Mars Observer (MO), Mobile Satellite (MSAT), Ocean Topography Experiment (TOPEX/POSEIDON), Radar Satellite (RADARSAT), Roentgen Satellite (ROSAT), Space Shuttle Payloads, Space Radar Laboratory (SRL), Spacelab-J, Spacelab Life Sciences (SLS), Space Station Attached Payloads, Tethered Satellite System (TSS), Ulysses, Upper Atmosphere Research Satellite (UARS), U.S. Microgravity Laboratory (USML), and U.S. Microgravity Payload (USMP).

The Mission Operations and Data Analysis (MO&DA) category includes mission operations and data analysis tasks for all of OSSA's missions.

The Research and Analysis (R&A) category includes research and analysis tasks for all missions, and all aspects of OSSA's suborbital programs.

Mr. VOLKMER. I know we're doing very well with the big ones yet, even though we don't have a new start this year.

Dr. FISK. Right.

SPACE STATION UTILIZATION FLIGHTS

Mr. VOLKMER. We're still doing very well. My other question is something I want to continue and try to follow the gentleman from Iowa's questioning. On the utilization flights, back when we had the full station going up, it was my understanding that we were going to have three utilization flights while we were in the process of completing construction. Now we're going through the review, we've downgraded. Are we still going to have three utilization flights or are we going to have two or one?

Dr. FISK. We're going to aim for three.

Mr. VOLKMER. We're still going to have the three.

Dr. FISK. You know, there's kind of a simple point on that. We fly two to three spacelabs a year now, and I find it kind of hard to believe that if we have a station sitting up there—we've got all the power you want, we've got the volume, space that will continue the spacelab activities when the station is so much better for what we want to do—so that's what's going to happen. We're going to——

Mr. VOLKMER. You're going to replace the spacelab type of project just directly through the station, and it will go through the labs there at the station.

Dr. FISK. Right. Exactly.

Mr. VOLKMER. Thank you, Mr. Chairman. I don't have any additional questions. Well, maybe I do.

On the utilization flights, will those flights be solely for utilization or would they be in combination——

Dr. FISK. I would anticipate that they're solely utilization with one caveat on that. You know, we have a plan for evolving the instrumentation. You know, we're going to fly some not simple stuff but simpler stuff up in the early station and then gradually evolve to more complicated furnaces and stuff, and we might use our utilization flights to get that stuff there. But aside from that, they're all for utilization.

Mr. VOLKMER. Thank you, Mr. Chairman.

Mr. HALL. The Chair recognizes Mr. Cramer.

SCIENCE CAPABILITY OF SPACE STATION

Mr. CRAMER. Thank you, Mr. Chairman.

Dr. Fisk, I, too, have not been able to be here for your entire testimony, but I've absorbed as much of it as I could, and I want to ask you actually the same question but state it in a slightly different way two times. Would you talk to us about the overall effectiveness of the station redesign, especially as it relates to science capability?

Dr. FISK. I'd be happy to. The station, of course, is finishing its redesign now, and you'll hear about that shortly. From the user standpoint, we place requirements on the station for being able to do microgravity and materials research and life science research. In the case of microgravity and materials, we need power, we need low microgravity levels, we need long duration. From what I have

seen of the redesigned, restructured space station, those requirements can be met.

In the case of life science research, we will ultimately need long duration human presence on the station. The only issue there is that the permanently manned part of the station may slip, and so that——

Mr. CRAMER. Can I interrupt you? Has the life sciences research been delayed as a result of the restructuring?

Dr. FISK. Yes and no. There are some aspects of life science research that you can do on the early station in a very unique way. For example, in the course of building the station, we will do EVAs—extra vehicular activities. Nowhere near the number that people worry about. This is not a big problem anymore. But nonetheless we're going to do more EVAs that at any point essentially in the history of the Space Program or anybody's space program.

So then you say, "Well, gee, what I ought to do then is some research in human physiology using the EVA activity as an experiment, basically," because whenever you think of human exploration into the solar system, it's bound to involve EVA—construction on orbit, marching around the lunar surface, whatever you want, and we have a very unique opportunity in the early station with this EVA activity to do some life science research there which is unique to that event.

But if you say, "Will we be delayed because we don't have long duration human presence?" yes. But there are still things to do which are important early on.

Mr. CRAMER. Thank you, Mr. Chairman.

Mr. HALL. I understand that the gentleman from Missouri has an additional question. We'll go ahead and ask it. I'm the only one that hasn't had a chance to go on to my questions.

Mr. VOLKMER. I thought the others had——

Mr. HALL. No, everybody's had their shot.

REPAIRS TO HUBBLE SPACE TELESCOPE

Mr. VOLKMER. I meant to ask you and forgot, Dr. Fisk, on the Hubble, as I understand it, we've got several things—you know, back when we did the Hubble, we knew we were going to build a new generation of instruments and put them in there. We didn't anticipate that the optical instrument was going to be bad when we put it up. Now, as I understand it, back when we had our hearings last year, we were going to replace the optical instrument with a new instrument and do some other things. Are we going to be able to do all of those things within our budget?

Dr. FISK. The answer is yes, within the budget that's proposed here. Here's the issue. We have repairs to make on Hubble, obviously. The principal instrument is the WF/PC—wide field planetary camera—and we are on schedule to in 1993 replace WFPC on orbit with another WF/PC which corrects the deficiency in the mirrors on Hubble. So that's under way.

Mr. VOLKMER. Could you stop right there for a minute?

Dr. FISK. Certainly.

Mr. VOLKMER. When we do that, what about the rest of the instruments that that's working with? Are they not degraded to some extent?

Dr. FISK. Thank you for that, because that's what I was going to say next.

Mr. VOLKMER. Okay. Go ahead.

Dr. FISK. There is a proposal which is under evaluation called COSTAR—I'd have to stop and think what the acronym stands for—basically, it is a device——

Mr. VOLKMER. Corrective optical instrument.

Dr. FISK. Corrective Optic Space Telescope Axial Replacement something.

Mr. VOLKMER. Right.

Dr. FISK. The idea would be to replace the High-Speed Photometer and in that slot put COSTAR, and COSTAR then opens up and places essentially two mirrors in front of each of the other instruments, and as a light bounces between those two mirrors, the spherical aberration is removed.

Now, then you've got two questions to answer about COSTAR. One is can you do it? It's a technical question. It's a lovely idea, it's a brilliant idea, but now you've got the practical question of is it going to work, and there is a full court press under way to evaluate that leading up to a decision in the May time frame.

The second question you face is a budgetary one, because we have a line in the budget for replacement instruments, and it would be our plan to use the money in that line to do COSTAR, and the consequence of that could be to delay not the WF/PC instruments but the generation of instruments that comes beyond WF/PC. So we're working now with the science community to ask their opinion in particular on if the consequence of doing COSTAR is to delay second generation instruments, do we want to do it? We'll get a position on that, and as I keep saying to people, I can't wait to see how the Associate Administrator makes his decision.

Mr. VOLKMER. That's a decision to be made around the first of May?

Dr. FISK. That's correct.

Mr. VOLKMER. Undoubtedly, if it was decided not to go with COSTAR, then we would go along and proceed with the next generation in the original plan.

Dr. FISK. Yes, on the original schedule, and then the repair mission would involve the WF/PC and the solar arrays. I mean, don't forget that we have two problems with Hubble—one, the spherical aberration, and the second is the jitter caused by the thermal expansion of the solar array.

Mr. VOLKMER. Right.

Mr. Chairman, I'd appreciate it if we could get a report from the NASA Associate Administrator around the first of May on this. Thank you, Mr. Chairman.

Mr. HALL. Does anybody else want a second shot before I make some inquiries?

[No response.]

Mr. HALL. I guess I just want to talk with you. I'm not sure I'm smart enough to ask you questions, but there are some things that I know that I want to know. How do you feel about NASA now and

your position in the eyes of this country, the taxpayers, this Congress?

Obviously, you've noticed here on this committee—and I don't know what you hear when you visit other committees, but I'm really speaking in generalities—but you've had a lot of real setbacks, even to cause a member of this subcommittee to ask you about firings or changing of subcontractors or contractors or making some major changes there; you've had the problems with the telescope; you've had the tragedy, the loss of the Atlas, and now we need a new orbiter; the change of the space station design; you have roll-backs, which are minor, I agree, but if it's a contagious type of hinge disease that you've got down there and it's going to cause the delay of the Gamma Ray Observatory launch and others—if I were you and if I were NASA, I'd really feel like I needed to take the lead in suggesting some changes and suggesting some budgetary constraints that you can live with and still produce with. How do you feel about that?

Dr. FISK. Well, clearly I don't have a set answer to this, so let me just chat back at you on the subject.

Mr. HALL. And I want to help, not hurt.

Dr. FISK. Let me take this from my own knothole, which is the Space Science Program, for a moment and kind of review several years here. We had a whole series of what I think you'd have to call triumphs.

Mr. HALL. Obviously. A lot of pride.

Dr. FISK. With Voyager, people cheered in the streets. We put up Magellan, we put up Galileo, and so on. Then we hit Hubble.

Mr. HALL. But people remember the bad.

Dr. FISK. They remember the bad.

Mr. HALL. Of the 12 the master picked, the only one most folks can name is Judas. [Laughter.]

Dr. FISK. The Hubble thing was clearly an event that people remember, and then you say, "Well, what was the event?" The event was that 10 years ago a small group in a contractor's organization did some really stupid things. They had some data that was available to them that they ignored, it was not reviewed adequately, whatever, and the result was that a mistake was made, there was no way to catch it after a few years, and it was built into the program, and it was revealed like something rising from the past 10 years later.

Now, I guess the thing that bothered me the most about the Hubble event was the sense in the public, perhaps the Congress as representatives of the public, that failure and setbacks were simply unacceptable. NASA is in the business of pushing the frontier. If we're doing something simple here, you're not getting your money's worth. I mean, we're asking for $15 billion here. We are trying not to do routine things, we're trying to press the frontier, we're trying to press new technology, give you knowledge that the human civilization has never had before, and there are going to be failures. Some of them are going to be stupid failures, like the Hubble mirror. Some of them are going to be things where the technology was a real challenge to execute, and the complexity of it was beyond our reach, and we ended up falling short.

But I think the thing that perhaps worries me the most is the message we have sent out as a result of Hubble problems and other things at the agency that we simply will not tolerate failure. If you won't tolerate failure, you do not encourage risk. You do not encourage people to take risks. That should not be the message. The message to the people, to students, to new engineers, to people who are going into high technology is take the risk, because there will be triumphs along with the failures, and we will reward you for the triumphs, we will tolerate the failures so long as you're always taking prudent risks in trying to achieve something that nobody else has ever done before. I would hope that as we view the ups and downs of the Space Program we view it in that context.

Mr. HALL. I don't think that's unreasonable, and I can accept the telescope situation more readily than at this date the change of the design of a space station. I really can't understand why that was not foreseeable, and I think where all of us are really failing the public is in not pointing out that much of the work that's gone into that can be used into the new station and that we don't have to do away with the peer holes we've drilled and the studs we've cut and the openings that we've laid out for what we're going to build up there. I guess you have peer holes up there, don't you? [Laughter.]

But you know what I'm asking. The money we've put into that——

Dr. FISK. If you want to categorize the fact that the station had to be redesigned here as a setback, you say, "Well, what was the setback there?" The setback was we reached too far on what the budgetary climate would permit us to have.

Mr. HALL. But if you've learned anything from the space station, you'll surely put it into effect on the EOS. Keep it simple and not fire until you're really ready to fire.

Dr. FISK. I think we will. There is a very fundamental difference between EOS and the station.

Mr. HALL. But it's perception. I'm talking about perception. We operate on 51 percent, all of us up here do, as the perception of the job we're doing, and the perception of the people is that the tragedy was weather-related. It probably wasn't, but that's the perception of most people I talked to. Atlas fired into a weather-related situation. That's their perception. That's what we have to answer, and that's where we hope that you've got one old creaky, crow-eyed guy down there that can walk out and say, "It looks like it might rain today" before you launch. Because we have to deal with perception.

Dr. FISK. That's fair. We do try and do that. You know, when we start these programs and we set out on this path together, they do need to be hand-in-hand in terms of——

BIOMEDICAL RESEARCH IN SPACE

Mr. HALL. That leads me to something that I've inquired about, and I think you know of my interest in the space medicine research, and you were kind enough to write me a letter about it that was helpful. Just to nail the paragraphs down to one sentence for each paragraph, you said, "Medical developments such as automated devices to monitor blood pressure and implantable devices to

treat diabetes can be attributed directly to NASA research." The next paragraph, the crux of it is, "The SLS-1 has a comprehensive payload developed to investigate how the function of the heart, lungs, and blood vessels respond to weightlessness." The next paragraph basically says, "The biomedical community believes that this cooperative research can yield important clues to the understanding, prevention, and treatment of osteoporosis." The next paragraph says, "Studies with human cell and tissue cultures on the ground and in space can have direct relevance to understanding cancer induced by various radiation environments."

That's good news. That's part of the triumph and the success that you've known there but still have to pursue. Really, the second part of my inquiry would say to initiate that pursuit, even before we get a space station, and what you really are telling me in this letter here is that we don't really need to use the Russian space station, and I say that if it brings any solution of those dreaded diseases one month or one year or one day or, in some instances, one hour earlier, why not use it and glean from them the mistakes that they've made in their space station to benefit us when we build ours? We would be solving some of the solutions of medicine at the same time.

Let me go on and just give you my full 50 cents worth before you answer, because I understand to go to the Russian space station we'd have to go on the Soviet spacecraft. For some reason our shuttle doesn't get to that inclination, and we don't have a place to tie up there, either. I think you call it docking. So I know we'd have to be using a lot of theirs, and it might knock our pride around just a little bit not to have our own space station, but the hard, cold fact is we don't have it. I'm not alone on this committee in having an interest in biomedical research and the pursuit and the possibility of finding a cure there that we have not been able to find after billions of dollars have been spent here in a weightless environment. Why not use it?

Dr. FISK. Well, there's no intrinsic reason not to. I think one thing we ought to just be a little careful of is we don't necessarily have to go there ourselves to use their space station.

Mr. HALL. Well, they have different interests basically than us, don't they, and different pursuits?

Dr. FISK. They do a great deal of very basic life science research. Their life science research is probably more targeted at long duration human flight, which, of course, has spinoffs for biomedical research.

Mr. HALL. Let me ask you a question. The French and the Germans are using it. Do they go there themselves?

Dr. FISK. Occasionally there is a French and there will be a German—I don't know whether to call them astronaut or Cosmonaut in that case—who will fly on the Russian space station. I would not argue, however, that's really for scientific reasons. Those are often flown for political reasons as opposed to doing scientific research.

One thing that you didn't mention but that has been a program of enormous impact on the life science activity is our flying on BIOSAT, which is the Soviet retrievable biological satellite. I got a briefing a month or so ago, and 40 papers are being published in

the major biological journal, whatever the appropriate biological journal is, on extremely basic, fundamental life science research on cellular cultures and enzymes and various things that are a concern to biological research as a result of flying rodents and primates on the Soviet BIOSAT, and that is a program that we have done jointly with the Soviets for 10 years, 15 years. I mean, it went right through the darkest days of the Cold War. Nobody ever asked us about it, and we kept having a wonderful time.

I think this is in many ways a precursor to LIFESAT, which we would ultimately do ourselves, but we've taken advantage of the Soviet spacecraft in a joint program, and it's very fundamental life science research, and I'd be pleased to send you some of the——

Mr. HALL. If you would, I'd like very much to have it. On the life sciences that the Russians are talking about using, how great is their equipment?

[The information follows:]

Following is a copy of the January 1990 edition of *The FASEB Journal*, a publication of the Federaton of American Societies for Experimental Biology. This edition of *The FASEB Journal* contains a summary of the 1987 COSMOS mission and 16 life sciences research papers based on data acquired as part of this mission. Within the next few months, the *Journal of Applied Physiology* will publish a summary and research papers from the 1989 COSMOS mission; a copy will be forwarded to the Committee upon receipt.

Overviews

U.S./U.S.S.R. joint research in space biology and medicine on Cosmos biosatellites

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COOPERATION BETWEEN THE United States and the Soviet Union in the area of space biology and medicine was initiated in 1972, with the signing of the first "Intergovernmental Agreement on Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes." This agreement contained two major parts: *1*) To develop compatible rendezvous and docking systems for testing on a joint U.S./U.S.S.R. manned flight, and *2*) To establish Joint Working Groups in four scientific areas, one of these being Space Biology and Medicine.

The first part of this agreement resulted in the 1975 Apollo-Soyuz Test Project, which represents the high point of U.S./U.S.S.R. cooperation in manned spaceflight. The Soviet manned space program continues to emphasize extended duration spaceflights, with recent flights of 237, 326, and 366 days in space. On these flights the emphasis has been to study the long-term effects of microgravity on human physiology and behavior, and to test various countermeasures for microgravity-induced physiological deconditioning (1).

The second part of the agreement consisted of periodic Joint Working Group meetings to discuss problems and issues of mutual scientific interest in the fields of space biology and medicine. These meetings took place as planned, and at the October 1974 meeting, the Soviets invited the U.S. to fly biological and radiation physics experiments on an unmanned Soviet biosatellite, scheduled for launch in the fall of 1975. A group of 11 U.S. experiments were selected and subsequently flown on this mission, known as Cosmos 782. Cosmos 782 began a series of cooperative biosatellite missions that still continues. These joint biosatellite missions, of which there have been seven to date, are summarized in **Table 1**.

THE COSMOS SPACECRAFT

A modified Vostok spacecraft similar to that used in early Soviet manned spaceflights has been used for all of the Cosmos missions. It is a spherical craft approximately 2.5 meters in diameter, with a gross weight of approximately 2250 kg and a payload of 900 kg (**Fig. 1**). During flight, the power required by the spacecraft is supplied by batteries. The atmosphere within the craft is maintained at sea level conditions with a total pressure of 780 mm mercury, with a pO_2 of 135–212 mm and a pCO_2 of up to 7 mm. The balance of the atmospheric gas is nitrogen. Relative humidity within the spacecraft during flight is 56–66%. Gaseous impurities generated within the cabin, such as ammonia and methane, are kept at low levels by circulating the cabin air through canisters containing absorbent materials. Ambient temperature within the spacecraft during flight ranges from 22 to 25.5°C.

JOINT U.S./U.S.S.R. COSMOS PAYLOAD DESCRIPTIONS

The payload descriptions of the past joint U.S./U.S.S.R. Cosmos biosatellite flights are summarized below.

Cosmos 782

Cosmos 782 was launched in 1975 and recovered after 19.5 days. The 11 U.S. experiments used male Wistar rats, *Drosophila melanogaster*, *Daucus carota* var. *carota* cell cultures, *Agrobacterium tumefaciens* crown gall on carrot discs (*Dacus carota* L. var. *sativa* DC), and fish eggs (*Fundulus heteroclitus*) as research specimens. The rat experiments focused on the microgravity effects on the endocrine, lymphoid, blood, muscle, and bone tissues. **Figure 2** shows the rat-holding unit with its individual rat cages. The experiments with the other species concentrated on comparing the effects of microgravity to artificial gravity levels of 1 and 0.6 g, produced by an on-board centrifuge, with respect to genetics, growth, development, and aging. In addition to the biological experiments, the U.S. also performed a radiation physics experiment (2).

Cosmos 936

The Soviet Union launched Cosmos 936 in 1977, and recovered the satellite after 18.5 days. Aboard the biosatellite were 30 young male Wistar rats, 20 of which were exposed to microgravity during flight; the remainder were subjected to a 1 *g* acceleration by con-

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TABLE 1. *U.S. Cosmos biosatellite participation*

Cosmos	782	936	1129	1514	1667	1887	2044
Launch date	11/25/75	8/3/77	9/25/79	12/14/83	7/10/85	9/29/87	9/15/89
Recovery date	12/15/75	8/22/77	10/14/79	12/19/83	7/17/85	10/12/87	9/29/89
Mission (days)	19.5	18.5	18.5	5.0	7.0	12.5	14.0
Apogee	405 km (218 nmi)	419 km (226 nmi)	406 km (219 nmi)	288 km (155 nmi)	297 km (160 nmi)	406 km (219 nmi)	294 km (159 nmi)
Perigee	226 km (122 nmi)	224 km (121 nmi)	226 km (122 nmi)	226 km (122 nmi)	222 km (120 nmi)	224 km (121 nmi)	216 km (117 nmi)
Period (minutes)	90.5	90.7	90.5	89.3	90.0	90.5	89.3
Inclination (degree)	62.8	62.8	62.8	82.3	82.3	62.8	82.3
Number of U.S. experiments	11	7	14	5	1	26	29

tinuous centrifugation. **Figure 3** shows one of the two on-board centrifuges, and **Fig. 4** shows the arrangement of the rat habitats and flight centrifuges within the spacecraft. One-half of the rats were killed at the recovery site within 4.5 h of landing, and the tissues were then prepared for transfer to U.S. investigators' laboratories for analysis. The remaining rats were killed after 25 days of readaptation to earth's gravity. The 1 *g* centrifugation of the rats during spaceflight reversed nearly all spaceflight effects. There were also U.S. experiments on board involving *Drosophila* and radiation physics (3).

Cosmos 1129

Cosmos 1129 was launched in 1979 and recovered after 18.5 days. This payload included 30 young male Wistar rats that were used for a wide range of physiological studies. The 30 rats were divided into five groups, which were killed at various times from 7 h to 29 days postflight, in order to study readaptation to the earth's gravity. A 1 *g* centrifuge control for rats was not available on this flight. In addition to the 30 rat cages described above, the spacecraft contained a rodent mating chamber, which housed five female and 2 male Wistar rats (**Fig. 5**). Fertilized eggs of the Japanese quail (*Coturnix coturnix*) were flown to determine the effects of space flight on avian embryological development. In addition, *Agrobacterium* growth on *Dacus*, *Dacus* cell cultures, as flown on Cosmos 782, and radiation physics experiments, as on Cosmos 936, were also on board (4, 5).

Cosmos 1514

Cosmos 1514, launched in 1983, represented a significant departure from the previous biosatellite flights. In particular, it marked the first flight of nonhuman primates (*Macacca mulatta*) by the U.S.S.R., and the first flight of pregnant Wister rats. This flight, scheduled for up to 14 days, returned after 5 days in orbit to ensure the safety of the two rhesus monkeys. The U.S. rhesus monkey experiments involved circadian rhythm, thermoregulation, cardiovascular blood pressure and flow, and calcium metabolism. Only one of the two rhesus monkeys was instrumented for the cardiovascular experiment. The U.S. rat experiments focused on developmental morphology and early neonatal development. A centrifuge was not flown on this mission because additional power and space were required for the rhesus habitats and experiments (6, 7). **Figure 6** shows the capsule for maintaining rhesus monkeys in flight.

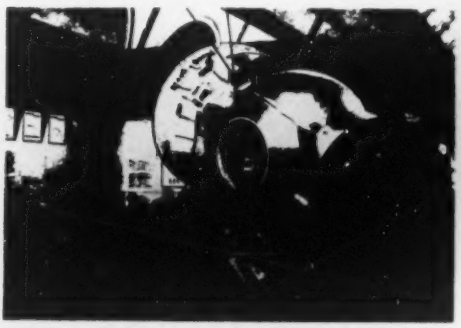

Figure 1. Cosmos 782 Spacecraft on display in the Moscow Space Museum. The circular viewport was installed for display purposes.

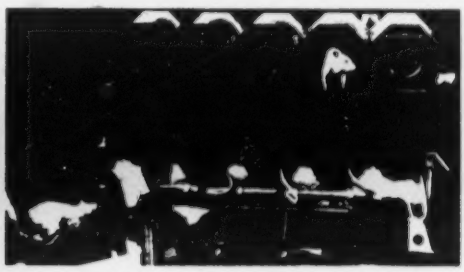

Figure 2. Rat cages of the individual type flown on Cosmos 782, 936, and 1129 flights. Cages were placed aboard in blocks of five cages that share common food and water reservoirs. Cages were also equipped for telemetric monitoring of body temperature and motor activity.

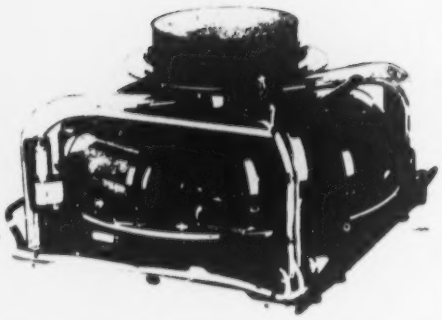

Figure 3. One of two rat centrifuges used during the Cosmos 936 mission. Each centrifuge had a radius of 320 mm, and rotated at a rate of 53 rpm to create an artificial gravity of approximately 1 g. Each centrifuge contained five individual rat cages.

Cosmos 1667

Cosmos 1667 was launched in 1985. The only U.S. experiment involved the measurement of cardiovascular blood pressure and flow, subsequent to the Cosmos 1514 experiment. As in Cosmos 1514, only one of the two rhesus monkeys was instrumented for this flight. In addition to the flight experiment, a postflight control experiment was conducted using the same flight animal approximately 1 month after the landing (8).

Highlights of selected research results obtained from the U.S. Cosmos flight experiments prior to Cosmos 1887 are shown in **Table 2.**

Cosmos 1887

For this mission, U.S. investigator participation in 22 rat experiments represented a significant increase over previous flights. There was also one rhesus bone density experiment and three radiation physics experiments (located both inside and outside of the spacecraft). Many of the investigators had previously flown rat experiments on the U.S. Spacelab 3 Mission in June, 1985 (9).

Cosmos 1887 was the sixth cooperative biosatellite mission for the U.S. and the U.S.S.R. The spacecraft was launched on September 29, 1987, and returned to earth on October 12, 1987, approximately 1800 miles downrange from its intended landing site. A system malfunction caused the satellite to land 8 s later than planned.

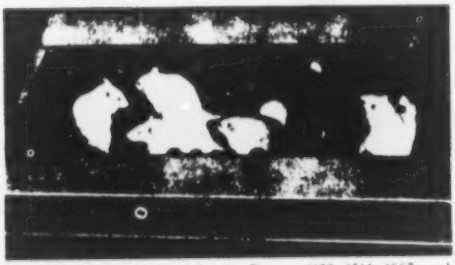

Figure 5. Rat habitat used for the Cosmos 1120, 1514, 1667, and 1887 flights. This habitat can house up to 10 rats. The separator was used only for Cosmos 1129.

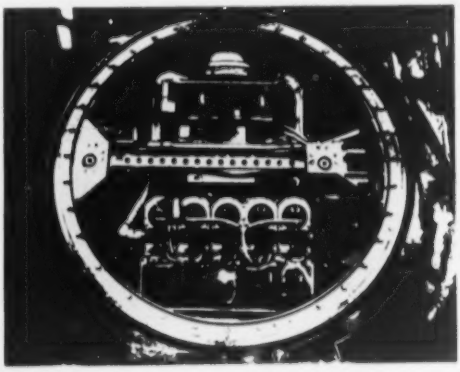

Figure 4. View of the inside of the spacecraft cabin. This is a mock-up unit that was used for the synchronous ground control experiment during the Cosmos 936 mission. Below is an end view of a block of five rat cages; behind are three more blocks, giving a total of 20 cages. Above the cages is a platform with two centrifuges, one in front of the other, which contained a total of 10 rats.

Approximately 3 h after landing, the spacecraft was located in Northern Siberia. Since the weather at this landing site ranged from −5 to −20°C, a heated tent was placed around the vehicle to protect the specimens from the cold. The lights had extinguished at landing and the animals remained in the dark until they were put into transport cages. The biosatellite's ventilation system continued to work after landing, although there was no heating. It is estimated that the internal temperature of the biosatellite dropped from its normal 23°C to approximately 15°C.

As a result of the delayed recovery of the specimens, the killing and dissection of the rats did not begin until 48 h after landing. The tissues were returned to Moscow for final processing and preservation before being shipped to U.S. laboratories for analysis. In all, more than 2000 individual tissue samples from the Cosmos 1887 mission were shipped to U.S. laboratories for analysis (10).

Some of the results of these scientific investigations are included in this volume.

Cosmos 2044

This mission was launched September 15, 1989, and landed 14 days later on September 29. It included 29 U.S. experiments: 4 primate experiments studying neurovestibular, muscular, circadian rhythm, and thermoregulation responses to weightlessness; 24 rat experiments, primarily repeating the Cosmos 1887 investigations; and a radiation physics experiment. The U.S. sent 21 academic and NASA scientists to Moscow to support postflight primate testing, tissue cell culturing for rat experiments, and postflight processing of rat samples.

FUTURE PLANS

Cosmos '92

The U.S. has been invited to propose experiments and hardware for a Soviet biosatellite flight tentatively scheduled for the summer of 1992. It is anticipated that two male rhesus monkeys and perhaps 10 male rats will again be flown for up to 14 days. Negotiations concerning experiments for this flight will begin shortly after completion of the Cosmos 2044 flight.

In addition to the Cosmos series of unmanned biosatellites, preliminary discussions are in progress for joint U.S./U.S.S.R. experiments on the Soviet Union's manned Mir space station, possibly in the middle 1990s.

NASA's first dedicated Space Life Sciences flight (SLS1) is scheduled to fly on a manned space shuttle in August, 1990. The U.S. invited Soviet scientists to participate in rat experiments planned for this mission, and they responded with 17 experiments that have been accepted by the U.S. The Soviets will receive postflight rat samples in the same manner as the U.S. receives samples from the Cosmos flights. The Soviets have also been invited to participate in the Second Life Sciences Spacelab flight (SLS2) scheduled for flight in 1992. This flight is expected to include four squirrel monkeys, in addition to rats.

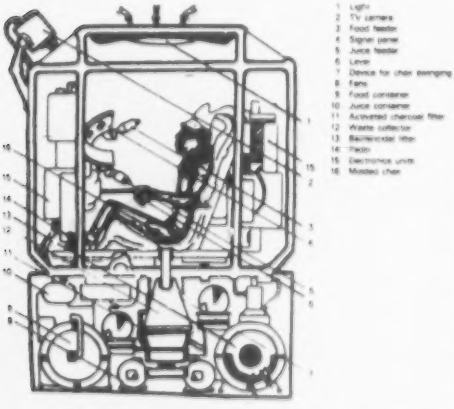

Figure 6. Capsule for maintaining rhesus monkeys in flight, showing primate compartment in biosatellite.

TABLE 2. *Highlights of results from U.S. experiments on Cosmos spaceflights*

Animals
• Decreased bone growth rate
• Decreased bone-breaking strength[a]
• Muscle atrophy and altered biochemical composition[a]
• Increased level of red blood cell hemolysis[a]
• Altered liver enzymes[a]
• Decreased energy consumption[a]
• Altered behavior, performance, and appearance[a]
Insects
• Altered behavior and aging
• Normal development
• No significant mutations
Plants
• *Agrobacterium* tumors on carrots (*daucus*) were smaller
• Early tissue development was normal
Microorganisms, cells, and tissues
• No substantial changes in growth and reproduction

[a]1 *g* Centrifugation of animals during spaceflight reversed these effects.

BENEFITS OF THE JOINT U.S./U.S.S.R SPACE MEDICINE AND BIOLOGY RESEARCH PROGRAM

The United States' involvement in the Cosmos Biosatellite Program has proved to be most beneficial for U.S. life scientists. It has provided seven flight opportunities in 14 years. U.S. funds for these flights have been used for experiment development and analysis, mission logistics, and project management for U.S.-related mission activities. All launch-related costs have been borne by the Soviet Union. The length of the early Cosmos missions was nearly three times Shuttle's current capability. Recent Cosmos missions, with the increased reliability of primate-support hardware, are approaching twice Shuttle's capability. This makes the Cosmos biosatellite particularly attractive for studies requiring longer exposures to microgravity. Cosmos 1514, 1667, 1887, and 2044 have provided a testing ground for the development of U.S. experiments and flight hardware. These missions have established an experience base among U.S. scientists and engineers that may easily be transferred to U.S. programs, such as the STS Shuttle and Space Station Freedom. An extremely important benefit of this program, which should not be overlooked, is the level of international cooperation and scientific camaraderie that has developed among representatives of the two countries during the course of accomplishing these many joint missions.

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Cosmos 1887: science overview

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ACCESS TO THE SPACE ENVIRONMENT offers opportunities to the biomedical community and a challenge to human well-being. Exposure of animals to the microgravity environs can be expected to materially advance our understanding of the role of gravity in biological function and structure. It is also plausible that spaceflight organisms will provide a useful tool for investigation of earthly afflictions such as osteoporosis. Observations of human beings suggest that space voyagers sustain a number of physiological changes in response to their environment. Space-induced changes, such as decreased mass of antigravity muscle, appear to be adaptive. For others, however, such as altered immune function, it is not clear if the changes are adaptive or pathological. It is also not known if the physiological changes would compromise human performance during a lengthy flight, on return to earth, or when landed on another planet. In the face of the known responses to flight it is reasonable to assume that, barring appropriate countermeasures, work capacity for some tasks would be limited. There is a dearth of definitive data on the scope of microgravity-related changes, on the mechanisms mediating these changes, on the readaptation to the Earth's gravity, and on effective countermeasures.

Resolution of at least some of the issues raised above requires the use of animal surrogates in space. To that end the sixth in a series of Soviet-U.S. collaborative animal flights was flown for 12.5 days. The Cosmos 1887 mission carried 10 male rats as part of its payload. Twenty-two groups of American investigators participated in the joint studies of these animals. The studies embraced skeletal muscle, bone, endocrine, neural, intestinal, metabolic, immunology, cardiac, and gonadal investigations. The flight was terminated earlier than its nominal 14 days because of a faulty monkey feeder and it overshot the designated land site, delaying killing of the animals and complicating postflight care. Nonetheless, a wealth of data was obtained from this mission. A summary of these studies and considerations in interpretation of the results are presented here.

Rat experiments on the Cosmos 1887 spaceflight had three general objectives. The first was to verify previous observations of the biological responses to microgravity. A second objective was to further elucidate effects of microgravity by extending the scope of previous studies, in both the tissues investigated and the measurements performed. The third objective was to relate biological responses to flight duration. It was hoped that the mission, midway in length between previous flights of 5–7 (1, 2) and 19–22 days (3–5), would provide insight into the time course of the various adaptive responses to spaceflight. That is, do microgravity phenomena such as muscle atrophy become progressively greater with increased exposure to microgravity, reach a new steady state, or show evidence of recovery? The first objective was met fully and the second with varying degrees of success. The confounding effects of overshooting the designated landing site and delayed recovery of the animals, detailed elsewhere (6), largely precluded meeting the last objective.

Many of the studies were repeated from the shorter Space Laboratory 3 (SL3) and/or longer Cosmos 782, 936, and 1129 flights. In areas that have been investigated previously, additional new experiments were done such as measurements of muscle mRNA, myosin isoforms, myofibrillar protein, and single-fiber concentrations of a number of enzymes and, for bone, studies of regional mineralization. The scope of hepatic enzyme studies was broadened for this mission. Immunology studies were modified from those done on SL3 to complement Soviet studies and maximize tissue use. Investigations were performed for the first time (or for the first time by American scientists) on brain and spinal cord enzymes, a neurotransmitter, transmitter receptors, hypothalamic regulatory factors, pineal metabolites, atrial granules, liver histology, and jejunal mitotic rate in spaceflight animals.

METHODS

Data from spaceflight rats were compared with those of three earth-base control groups: basal control group, killed near the time of launch; synchronous controls, maintained like flight rats; and vivarium controls, which were kept under usual laboratory conditions. Comparisons cited below, unless otherwise noted, are between flight and synchronous control groups. Animal maintenance in flight, postflight care, and killing have been described (6). Analytical procedures have been described with each of the original articles cited.

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RESULTS

Bone studies

Studies of the tibia revealed no differences in bone or marrow canal cross-sectional areas or other morphometric measurements between flight and control rats (7). In contrast, the humeri of flight animals showed decreases in these parameters (8). The reason for these differences between the tibia and humerus is not apparent.

Mineral concentrations of the whole femur, tibia, humerus, lumbar vertebra, and mandible were similar for flight and control groups (8–12). The calvarium, however, showed decreased calcium, phosphorus, and ash after flight (12). Four of the five femurs from each rat group were cut into pieces, analyzed chemically, and compared with microtomography data from the whole fifth femur (9). The two procedures yielded essentially the same results, that is, a longitudinal gradient of decreasing mineralization in the flight femoral diaphysis. These results indicate that a mineralization deficit occurred during the 12.5-day flight and that not all regions of the bone were equally vulnerable. Further evidence of disturbed mineralization was shown by density gradient studies (12). Bone particles of flight rat calvaria were preponderantly distributed in the lower density range, indicating an abundance of poorly mineralized particles. Relative to controls there was a paucity of flight bone particles at the higher densities, where more completely mineralized bone is found. The smaller hydroxyapatite crystals of flight rats are also consistent with retarded mineralization (12). Collagen abundance was unchanged in flight rat bones but collagen cross-linking was reduced (8, 9) and the collagen fibrils were wider (13). Alkaline phosphatase was not increased in bones of flight rats (14), but serum alkaline phosphatase of bone origin was (6).

Bone growth was retarded by flight as shown by decreased longitudinal growth of the humerus (8) and thinner tibial growth plates (13). The proliferative zone of the epiphysis was increased in size and cell number, suggesting recovery after flight; however, the zone of hypertrophy/calcification was significantly decreased, indicating reduced growth in flight. The higher concentration of magnesium found is also compatible with a delayed maturation in flight (12). Conflicting information on bone growth came from electrophoresis of bone particles (10). Results of these latter studies revealed a greater negativity of the bone particles, which suggests an increase in newly formed bone. The increased numbers of preosteoblasts and decreased progenitor cells also suggest that recovery of the osteocyte precursors had begun quickly after flight (14).

Bending strength, but not the modulus of elasticity, was decreased in the humeri of flight rats (8). This decrease is attributed to the changes in geometry of the humerus. Doty et al. (7) found degradative changes in the bone vasculature with decreased endothelial enzymatic activity and lipid accumulation in the vessels. Swelling pressures of lumbar intervertebral discs were similar for flight and control rats (15). Whether the pressure did not change in flight, or had recovered after flight, is unknown.

Muscle studies

Absolute weights of a number of skeletal muscles, of differing predominant fiber type and function, were 15–22% less in flight rats (unpublished results). The differences in weight were less than those seen in previous flights. For example, the soleus (Sol) absolute weight typically is 35–40% less in flight rats, but for Cosmos 1887 it was only 15% below control weight. Expression of the Sol weight as a function of body weight showed essentially no difference between flight and control muscles. The Sol and adductor longus (AL)[2] were edematous, which may have obscured larger weight changes in the muscle fibers (16). Support for this view was provided by the observations that fiber cross-sectional areas were decreased an average of 40% for all types of Sol fibers and 36% for AL fibers (16, 17). Fiber size, calculated as weight/unit length, was decreased 35% for the Sol and tibialis anterior (TA) muscles (18). In the deeper region of the medial gastrocnemius (MG), fibers that stain dark for myosin adenosine triphosphatase sustained a 28% decrease in cross-sectional areas whereas superficial fibers of this type were reduced only 15% (17). Fibers of fast-twitch muscles showed less atrophy with decreases in cross-sectional areas of about 20% for the extensor digitorum longus (EDL) and plantaris (16). The two red muscles, Sol and AL, studied by light and electron microscopy and immunohistochemistry, showed a number of fibers with segmental necrosis, especially the AL (16). Activated satellite cells were present in some of the necrotic cells, suggesting that repair was being initiated. Fast-twitch muscles did not show necrotic fibers. Pathological changes were also observed in the microcirculation, as evidenced by extravasated erythrocytes and endothelial changes in the edematous areas of the AL (16). About 14% of the motor endplates of the AL also showed degradative changes. Increased plasma levels of creatine and urea nitrogen certainly suggest that skeletal muscle catabolism was elevated 2 days after landing (6, 19). Whether this is a continuing effect of processes initiated in flight, or a consequence of landing and weight bearing at 1 g, remains unknown.

Carbonic anhydrase III, tripeptidylaminopeptidase (TAP), and parvalbumin were measured in two muscles, the plantaris and extensor digitorum longus (20). The flight plantaris showed a decrease in TAP but no other changes were found in either muscle. In SL3 rats the EDL had increased TAP, suggesting that recovery may have reversed flight-related changes in this protease.

[2]Abbreviations: AL, adductor longus; TA, tibialis anterior; EDL, extensor digitorum longus; TAP, tripeptidylaminopeptidase; VI, vastus intermedius; GH, growth hormone; GRF, growth hormone releasing factor; SRIH, growth hormone release inhibiting hormone; 5-HT, 5-hydroxytryptamine; 5-HIAA, 5-hydroxyindole acetic acid; Sol, soleus

In the Sol the percentage of fibers expressing fast myosin heavy chain doubled and the percentage expressing fast and slow heavy chain myosins quadrupled. Slow myosin was lost but fast myosin was virtually unchanged in another red muscle, the vastus intermedius (VI) (21). Myofibrillar protein was decreased 35% (mg/g muscle) in flight VI muscle.

In the fast vastus medialis, protein and DNA concentrations (mg/g muscle) were unchanged, but RNA was decreased in flight rats (22). The mass of the triceps brachii was similar for flight and control rats as were messenger RNAs for cytochrome *c* and α-actin (23). Specific mRNA has not been measured previously in flight animals, but in the Sol of hindlimb-suspended rats these mRNAs decrease markedly as does protein synthesis; both mRNA and synthesis recover rapidly after suspension (24). It is not known if the mRNAs of this muscle were unaffected by flight or if they had recovered by the time of death.

Muscles that are predominantly slow or fast twitch, with varying functions, were investigated for their complements of oxidative and glycolytic enzymes after flight (16–18, 22). Conversion of Sol and AL fibers from slow oxidative to fast glycolytic and fast oxidative glycolytic occurred (16, 17). Five oxidative and five glycolytic enzymes and hexokinase were studied by Manchester et al. (18). The concentrations of oxidative enzymes increased markedly in the TA but were essentially constant in the Sol. In contrast, glycolytic enzymes increased slightly in concentration in the Sol but decreased modestly in the TA. These changes suggest that about one-half the fast glycolytic fibers of the TA were converted to fast oxidative glycolytic metabolism as a result of flight. Changes in enzyme concentration could reflect either a change in enzyme abundance and/or a change in fiber size. Thus, when the absolute enzyme activity per fiber was determined, the TA showed constant levels of three oxidative enzymes and markedly increased three ketoacid CoA-transferase and thiolase, but glycolytic enzymes fell 40%. In the Sol, however, spaceflight incurred a decrease of 25% in oxidative enzymes and a marginal decrease in glycolytic enzymes per muscle. The absolute quantities of hexokinase increased 25–50% in the Sol and TA in response to flight. The increased hexokinase suggests that the muscles were shifting to a carbohydrate-utilizing or storing metabolism. However, the increased 3 ketoacid CoA transferase found in the flight TA, but not the Sol, is also consistent with an increased fat metabolism. Similar effects of flight on metabolic enzyme activities were found for the other muscles studied.

Other studies

Several components of the endocrine system responded to spaceflight whereas others did not. Cardiac atrial granules, presumably containing natriuretic factor, were increased in number, but not size, in flight rats (25). Posterior pituitary gland concentrations of both vasopressin and oxytocin were decreased (26). Why posterior lobe hormones were depleted is uncertain as flight and synchronous controls were fed and watered in a similar manner (6). Interestingly, hypothalamic concentrations of vasopressin, estimated by immunohistochemistry, were similar for flight and control rats (27). Flight decreased secretion of growth hormone (GH) by pituitary somatotrophs about 50% in subsequent culture or when implanted into hypophysectomized rats (27), but intracellular concentrations (immunostaining) of GH were increased. Curiously, the hypothalami of flight animals contained decreased amounts of both growth hormone releasing factor (GFR) and growth hormone release inhibiting hormone (SRIH) as determined by immunohistochemistry. The similar concentrations of vasopressin and corticotropin releasing factor in flight and control rats suggest a specific effect of spaceflight on the hypothalamus. Pineal 5-hydroxytryptamine (5-HT) and 5-hydroxyindole acetic acid (5-HIAA) concentrations were increased after flight (28). If the increased 5-HT led to increased melatonin secretion, it could account for the smaller testes, slight decrease in spermatogonial numbers (29), and the large decrease in plasma testosterone (6) that were found. Plasma concentrations of thyroid hormones were lower in flight rats, but plasma corticosterone titers were not elevated even though their adrenal glands were hypertrophied (6). The enlarged adrenals indicate that these rats experienced sustained stress.

Tissues such as bone, certain muscles, and lymphocytes grow or replicate more slowly in space (2, 30). However, it is not known how general impeded growth is. To further clarify this question, the mitotic index of the jejunal mucosa was determined (31). No differences were found, which indicates that either there was no effect of microgravity or the mucosa had recovered rapidly after flight.

Spaceflight rats typically have livers as big, or bigger, than Earth controls. In the present flight, liver weights of both rat groups were statistically the same although the flight animals were about 15% smaller in body weight (19, 32). The disproportionately large livers of flight rats did not result from sequestered blood, edema, or lipid accumulation. Histological studies revealed that the livers had increased parenchymal tissue and increased vacuolization (32). The vacuoles were thought to contain glycogen. Chemical studies verified the increased parenchymal tissue (decreased mg DNA/g liver) and markedly increased glycogen (19). If the elevated glycogen levels occurred in flight rather than afterward, it is curious that they persisted even after a 42-h fast. Hepatic microsomal protein was also decreased after flight. A study of enzymes involved in carbohydrate, fat, and protein metabolism and xenobiotic metabolism revealed an increase in HMG-CoA reductase and decreases in aniline hydroxylase and ethylmorphine N demethylase. Cytochrome P-450 was also reduced. The aniline hydroxylase and cytochrome P-450 results suggest that drug metabolism may be altered by spaceflight. Serum concentrations of electrolytes and proteins were unchanged in flight rats, but cholesterol was increased. The 80% increase in HMG CoA reductase in the face of a 50% increase in serum cholesterol is paradoxical and suggests an alteration in regulation of this enzyme.

The left ventricle of flight rats showed edema, irregular mitochondria, and loss of actin and myosin filaments (33). Glycogen and lipids were increased and the mitochondrial density decreased. Investigation of the regulatory subunits of cyclic AMP-dependent protein kinase showed no change in RI (34). A second regulatory subunit, RII, however, was decreased in particulate subcellular fractions of ventricular tissue after flight.

Immunological studies were designed to test the responsiveness of immunogenic cells of bone marrow origin to colony-stimulating factor and to determine the subpopulations of immune cells obtained from the spleen and bone marrow (35). Cells of spaceflight rats showed a suppressed response to colony-stimulating factor. Among the immune cells, populations of pan T cells, suppressor T cells, and cells with interleukin 2 receptors were increased in spaceflight rats.

The concentrations of enzymes involved in energy metabolism or γ-aminobutyric (GABA) metabolism and the neurotransmitter were measured in multiple regions of the hippocampus and spinal cord (36). In various areas of the hippocampus of flight rats glutamate decarboxylase, GABA transaminase, and glutaminase were increased. In the spinal cord aminotransferase was increased whereas transaminase and glutaminase were decreased. β-Hydroxyacyl CoA dehydrogenase was decreased in dorsal horn tissue. Some of the determinations were too few, or the enzyme concentrations too variable, to allow statistically rigorous conclusions. Nonetheless, the data strongly suggest that spaceflight evokes changes in neuronal metabolism and that further studies are warranted. Daunton et al. (37) endeavored to quantify cholinergic (muscarinic) and GABA (benzodiazepine) receptors and glial fibrillary acidic protein in the frontal lobes of flight rats. The receptors and protein labeled satisfactorily but the investigators were unable to adequately localize the labels for strict quantitative comparison with control brains.

SUMMARY AND DISCUSSION

Even under ideal spaceflight conditions, animal studies do not yield pristine data on microgravity effects. In addition to the microgravity environment, spaceflight animals are exposed to launch and reentry *g* forces, noise, and vibration.

Studies in our laboratory have not shown any untoward effects of simulated space shuttle engine noise on growth and nursing behavior of earthling rat and mouse pups or on maternal behavior. Neither have centrifuge-simulated shuttle launch and reentry *g* forces a week apart elicited significant changes in behavior, several blood constituents, pituitary growth hormone concentration, muscle and organ weights, or growth of rats (unpublished results). Moreover, hindlimb suspension produces effects similar to spaceflight on several physiological parameters such as hindlimb skeletal muscle and secretion of growth hormone (38–40). Collectively these observations suggest that for many spaceflight studies the transitory *g* force exposure, noise, and vibration do not significantly aggravate or attenuate microgravity effects.

Appropriate earth gravity control animals are intended to compensate for these incidental factors. Nevertheless, it is not known what physiological responses to stimuli such as noise and vibration might occur in conjunction with the microgravity environment. Also, some environmental conditions, such as usable cage space per rat, cannot be controlled because of the ability of the flight animal to use the entire cage volume and the control rat to use only floor space. The limited number of animals that can presently be flown at one time and the difficulty in repeating the study further constrain flight experiments.

Attributing spaceflight effects to microgravity is even more uncertain because of possible recovery or exacerbation of microgravity effects in the interval between landing and sacrifice. In previous Soviet spaceflights the delay between landing and killing of the animals was typically several hours, and for Space Laboratory 3 the elapsed time was 11–17 h. In the present flight the delay in killing after touchdown was 48–53 h and was complicated by a 42-h fast and exposure to temperatures of 12–15°C (6). Controls were exposed to the same temperatures and fasting regimen as spaceflight animals but interpretation of the Cosmos 1887 data must still be tempered by these events.

Although killing the rats was delayed inordinately, a number of the data verify (at least qualitatively) findings from previous flights. Tissues studied on multiple flights such as bone, muscle, and pituitary yielded data that are comparable to previous results. Different caging systems (single, group caged), different diets (Soviet paste diet, Teklad L-356), and different strains of rats (Wistar, from the Institute for Experimental Endocrinology of the Slovakian Academy of Sciences, Bratislava, Czechoslovakia, and albinos, Taconic Farms, Germantown, N.Y.) have been used on the Soviet and American flights, respectively. Similar observations in repeated studies, despite the differences mentioned, strongly suggest that a common factor, microgravity, overshadowed these other considerations.

It is tempting to assume that fluid shifts and hormone secretion, unlike muscle and bone, would quickly readapt to the Earth's gravity whereby measurements of these substances would reflect only conditions after landing. However, in two spaceflights pituitary somatotrophs have shown decreased secretion for at least 6 days after flight, which suggests that the secretory cells sustained a chronic functional deficit. If growth hormone secretion is decreased, perhaps secretion of other hormones, and the tissues or substances they regulate, are also depressed after flight. Thus, it is impossible to distinguish flight-induced from postflight effects for many of the Cosmos 1887 studies with any degree of certainty. The observed changes can be ascribed only to spaceflight and recovery.

Future spaceflight studies need to address both the technical and scientific issues raised by the Cosmos 1887 flight. It is anticipated that rats will be recovered shortly after landing of the Cosmos 1989 and 1992 missions and the American Space Life Sciences-1 (SLS-1)

flight scheduled for late 1990. Rapid retrieval and killing of the animals will simplify interpretation of results. Further clarification of microgravity effects is expected for the SLS-2 mission, scheduled for 1992, in which animals will be killed in flight.

Three broad scientific issues need to be addressed in future flights. The first of these is to describe the responses of many tissues, not only weight-bearing and position-sensing tissues, to spaceflight at the tissue, cellular, and molecular levels. The Cosmos 1887 mission, at minimum, raised many questions about metabolic, endocrine, neural, and immune function, as well as skeletal muscle and bone, responses to microgravity. Understanding the mechanisms will necessitate investigation at these various levels as will rational development of countermeasures for human subjects on flights of long duration. The second objective is to describe, qualitatively and quantitatively, the course of the biological responses to microgravity. The ability to do longer-term studies of the space station in the middle 1990s should greatly facilitate this objective. Finally, the postflight recovery of the space-adapted tissues to the gravity of the Earth merits careful investigation; the completeness and rate of recovery need thorough study.

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Dr. FISK. I think their equipment is—I don't want to be critical necessarily, but the level of sophistication—our ability to make measurements, particularly on humans, in a non-invasive way—all these things that we've designed and some of which have had interesting spinoffs—is well in excess of theirs. That in many ways is a basis for good cooperation. They have the subjects and the space station, and we have the equipment.

Mr. HALL. I don't remember who said it, but I think we felt good during this war over there to see the money we spent on technology, and I think it was General Powell maybe that bragged on their SCUDs that they hadn't missed a single one of our Patriots. [Laughter.]

Are we going to do any more joint BIOSAT missions, and could they substitute for our LIFESAT Program?

Dr. FISK. The answer is no. There are two issues. One is I'm not sure the Soviets are going to continue the BIOSAT Program on their own, so that may be an opportunity that disappears. One of the things is that as a result of where the Soviets launch BIOSAT—and I've forgotten which of their centers it is—my recollection is it gets only into a 57-degree orbit, and one of the things that LIFESAT is designed to do is to get in truly a polar orbit so that you pick up the radiation dosages for studying radiation impacts on humans. Fifty-seven is certainly better than equatorial, but it's nowhere near polar.

Mr. HALL. Would it serve some purpose to you to use the Russian space station, to have access to it, even though it would involve putting our men and women into their shuttles and sending them on their vehicle, to their accomplishment? Is the jury out on that or has the door been closed?

Dr. FISK. I think the jury is a bit out on that. I'm more comfortable with vigorously pursuing the idea of joint science experiments using their facilities, and I think there are things that we are doing, there are probably more things that can be done there. The sending of one or two U.S. crews to the Russian space station is interesting, but the real thing the space station will bring is the long duration repetitive measurements, and that actually they can accomplish on their own with our participation.

Mr. HALL. Will this issue be addressed in their revised life sciences strategic plan, and when?

Dr. FISK. Yes. One of the issues that we—I can't tell you exactly the extent that it's in the strategic plan, but one of the aspects of our Life Science Program is continual cooperation with the Soviets.

Mr. HALL. Well, we outwaited Nagle. He had to leave. [Laughter.]

Does anybody else have anything?

The Chair recognizes Mr. Bacchus.

Mr. BACCHUS. Thank you, Mr. Chairman.

I appreciate the Chairman's remark. We're philosophical in nature, and very much in keeping with my own, I, too, am here to help, not hurt.

I grew up in central Florida in the 1960s. I'd sit in the back yard in my bare feet in the hot sand and watch the Mercury astronauts ride into the base. At the age of 20, I was a young journalist, and I watched them land on the moon. I support the Space Program. I

believe in your work, that's why I'm here. I have a responsibility to the people who live in my district and to all the people to make certain that we do the best job we can. I know you share that desire.

What I know of NASA is what I see in central Florida, and I know that there at the grassroots of the program there is the same spirit, there's the same commitment, there's the same desire to expand the horizon, reach out beyond the frontier that there was in the 1960s. You've read and I've read that there is a change in NASA since the 1960s, that the culture has changed. I haven't had the privilege yet of getting to know you or many of the other ranking administrators in the agency, and I look forward to doing so. It's clearly one of my priorities.

I hope—and indeed assume—that each of you at the highest level shares that same spirit that I still see at the grassroots. But we have a problem in persuading much of the Congress and the American people that what we're doing is a priority in terms of our continuing adventure into space. Part of the challenge of those of us in Congress who believe in the importance of the Space Program is to help explain to my colleagues about the importance of expanding our horizon, moving outward. Part of the challenge is yours as well.

I think my colleagues would be more supportive of the Space Program if they understood the tremendous commercial spinoffs that we get from the program better than they do. You know and I know that we have profited immeasurably commercially from our investments in space. We've received everything from Velcro and sunglasses to communication satellites of the highest order. Projects such as the Earth Observing System offer us incalculable potential advantages. You need to do a better selling job. I need to help make that sale.

But beyond that, I would appreciate your comments on the charge that NASA's culture has changed over the years, that there's not that same commitment at the highest levels, that there's not the entrepreneurial, pathfinding, youthful spirit that we saw 30 years ago. I don't happen to believe that youth goes away with age. It remains in the heart. Tell me about the heart of NASA. Tell me what you believe about the culture.

Dr. FISK. Well, thank you for the opportunity on that. First of all, I've been involved in the Space Program now since the mid-1960s. I've been at NASA as the Associate Administrator only four years, but I was an active researcher in space, I had numerous space projects, and so on, so the Space Program has been my life even if I have only been Associate Administrator for four years.

The youthful vigor is still here. It hasn't gone anyplace. You're looking at probably the youngest set of administrators that NASA has had since the beginning, first of all. I don't really think of myself as old enough here to have started to solidify in some way, and I think——

Mr. BACCHUS. We only want them, sir, to be young in spirit, like the Chairman.

Dr. FISK. That's right. And I think we are young in spirit. You do these jobs and you have this commitment to the Space Program because it's in your blood. That's what it's all about. I mean, I gave

up a very interesting career as a senior university administrator to come here, to be able to be part of the senior leadership of NASA, and you're part of the adventure.

Most of us still believe that when people look back on this generation hundreds of years from now, the event they are going to remember the most is the Space Program. Just in the same sense as if you asked yourself what happened in 1492. You don't remember that the Moors were beaten out of Spain. You remember that Columbus discovered America. If you were living in 1492, you probably barely noticed that Columbus went to America. The same thing is likely to happen, and we enjoy being part of that adventure.

So I don't see the spirit diminished in any way. Occasionally, we find ourselves frustrated because we want people to share the adventure enthusiastically with us and be supportive of it in the broadest sense, and that doesn't always occur. But the adventure is still with us, we're stubborn about being able to achieve it, and the risk takers are still here. We're not going to give up on the risks, and we're going to succeed most of the time, we're going to fail occasionally, and that's the way NASA has been since day one.

Mr. BACCHUS. Doctor, I certainly hope you're right about how people will look back on this century. We've clearly done more than enough damage to the human spirit in this century. I hope they will look back and look at all the good we've done for the human spirit, and I certainly agree with you that the Space Program is something good that we've done.

Thank you, Mr. Chairman.

Mr. HALL. Mr. Cramer, anything else?

Mr. CRAMER. Nothing, Mr. Chairman.

Mr. HALL. I really want to thank you, Dr. Fisk, and thank you, Mr. Diaz and Ms. Schmoll. We'll meet again on Tuesday, March 5, here at this same docking area, and we'll meet at 1:00. We'll have the Office of Commercial Programs and the Office of Space Operations in here that day.

Once again, I appreciate not just your presentation here but the time you put into it, and I want to have another shot at having a good coffee visit with you, Dr. Fisk and Ms. Schmoll and Mr. Diaz, when we can.

Dr. FISK. I'll look forward to it.

Mr. HALL. Thank you. We are adjourned.

[Whereupon, at 11:54 a.m., the subcommittee was adjourned, to reconvene at 1:00 p.m., on Tuesday, March 5, 1991.]

1992 NASA AUTHORIZATION

TUESDAY, MARCH 5, 1991

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON SPACE,
Washington, DC.

The subcommittee met, pursuant to recess, at 1 p.m., in room 2325, Rayburn House Office Building, Hon. Ralph M. Hall (chairman of the subcommittee) presiding.

Mr. HALL. First, I would like of course to welcome all of you to the Space Subcommittee's second hearing on the NASA authorization request for fiscal year 1992. Today, we're going to hear from NASA's Office of Commercial Programs and NASA's Office of Space Operations. The programs in these two offices are often not the most visible, but they are a very important part of our very ambitious civil space program.

The commercial potential of space is something that we in Congress have encouraged for some time. NASA's Office of Commercial Programs has put together a set of research centers to promote commercial involvement in space research, with the hope that some of these ideas might turn out to be profitable business ventures. This network of centers is still in experiment, so the subcommittee needs to explore how well they are progressing in terms of encouraging matching contributions from industry and fulfilling their ultimate potential to create new markets.

In addition, the Office of Commercial Programs is requesting a near doubling of their budget in fiscal year 1992. Most of this increase is for SPACEHAB and COMET. This subcommittee needs, I think, to understand how these programs fit into the overall commercial space effort and what choices will have to be made if NASA, and this office in particular, does not get its full budget request.

Our second panel today is from the Office of Space Operations in NASA. Space Operations supports all of NASA's space flight missions. We sometimes forget that the success or failure of space missions does not hinge only on what happens in space. What we do on the ground with the data generated by the missions is becoming increasingly critical, especially as we begin the Mission to Planet Earth Program. We need to make sure that we are devoting adequate resources to ensure that we are going to get our money's worth from the ambitious set of space missions that will fly in the coming decade.

I guess when we get to the question and answer area, we'll want to know what are the relative merits of SPACEHAB and COMET,

and what if we don't get all we want in either or both of them, and what steps we'll take there, and what are the priorities.

With that, I am pleased to turn the mike over to Mr. Sensenbrenner for any opening remarks he wants to make.

[The prepared opening statement of Mr. Hall follows:]

Opening Statement
by
Ralph M. Hall

NASA Authorization Hearing
March 5, 1991

GOOD MORNING. I'D LIKE TO WELCOME ALL OF YOU TO THE SPACE SUBCOMMITTEE'S SECOND HEARING ON THE NASA AUTHORIZATION REQUEST FOR FY 1992. TODAY WE WILL HEAR FROM NASA'S OFFICE OF COMMERCIAL PROGRAMS AND NASA'S OFFICE OF SPACE OPERATIONS.

THE PROGRAMS IN THESE TWO OFFICES ARE OFTEN NOT THE MOST VISIBLE, BUT THEY ARE IMPORTANT PART OF AN AMBITIOUS CIVIL SPACE PROGRAM.

THE COMMERCIAL POTENTIAL OF SPACE IS SOMETHING THAT WE IN CONGRESS HAVE ENCOURAGED FOR A LONG TIME. NASA'S OFFICE OF COMMERCIAL PROGRAMS HAS PUT TOGETHER A SET OF RESEARCH CENTERS TO PROMOTE COMMERCIAL INVOLVEMENT IN SPACE RESEARCH, WITH THE HOPE THAT SOME OF THESE IDEAS MIGHT TURN OUT TO BE PROFITABLE BUSINESSES. THIS NETWORK OF CENTERS IS STILL AN EXPERIMENT, SO THIS SUBCOMMITTEE NEEDS TO EXPLORE HOW WELL THEY ARE PROGRESSING IN TERMS OF ENCOURAGING MATCHING CONTRIBUTIONS FROM INDUSTRY AND FULFILLING THEIR ULTIMATE POTENTIAL TO CREATE NEW MARKETS.

IN ADDITION, THE OFFICE OF COMMERCIAL PROGRAMS IS REQUESTING A NEAR DOUBLING OF THEIR BUDGET IN FISCAL 1992. MOST OF THIS INCREASE IS FOR SPACEHAB AND COMET. THIS SUBCOMMITTEE NEEDS TO UNDERSTAND HOW THESE PROGRAMS FIT INTO THE OVERALL COMMERCIAL SPACE EFFORT AND WHAT CHOICES

WILL HAVE TO BE MADE IF NASA, AND THIS OFFICE IN PARTICULAR, DOES NOT GET ITS FULL BUDGET REQUEST.

OUR SECOND PANEL TODAY IS FROM THE OFFICE OF SPACE OPERATIONS IN NASA. SPACE OPERATIONS SUPPORTS ALL OF NASA'S SPACE FLIGHT MISSIONS. WE SOMETIMES FORGET THAT THE SUCCESS OR FAILURE OF SPACE MISSIONS DOES NOT HINGE ONLY ON WHAT HAPPENS IN SPACE. WHAT WE DO ON THE GROUND WITH THE DATA GENERATED BY THE MISSIONS IS BECOMING INCREASINGLY CRITICAL, ESPECIALLY AS WE BEGIN THE MISSION TO PLANET EARTH PROGRAM. WE NEED TO MAKE SURE THAT WE ARE DEVOTING ADEQUATE RESOURCES TO ENSURE WE ARE GOING TO GET OUR MONEY'S WORTH FROM THE AMBITIOUS SET OF SPACE MISSION THAT WILL FLY IN THE COMING DECADE.

I'D LIKE TO TURN THE MIKE OVER TO MR. SENSENBRENNER FOR HIS OPENING REMARKS.

Mr. SENSENBRENNER. Thank you very much, Mr. Chairman. The minority is not yet fully staffed as a result of Bill Gordon's departure to the private sector at the end of last month, so we will have no opening statement today. [Laughter.]

Mr. HALL. You don't write your own? [Laughter.]

Mr. SENSENBRENNER. When there is a need.

Mr. HALL. All right. I recognize the gentleman from San Antonio, Bear County, Mr. Smith.

Mr. SMITH. Thank you, Mr. Chairman.

Mr. Chairman, like you, I am pleased that Mr. Rose is here from the Office of Commercial Programs because I believe it is the commercial space industry that holds great promise for the future of U.S. competitiveness.

NASA's Centers for the Commercial Development of Space are especially valuable because of the university and industry research ties that are established. Two of these centers of course, Mr. Chairman, are located in Texas—one at the University of Texas and one at Texas A&M.

If the United States wants to encourage commercial space activities, then it must bring the needs of private industry better into focus. The COMET program is an excellent start in this direction. I would urge NASA to exercise caution though in proceeding with this program in a manner that does not crowd out other private investment.

I understand that there exists private proposals to develop hardware that would provide some similar services to those of COMET without Government funding. While these proposals might not compete directly with those of COMET, steps should be taken so that COMET does not exclude other companies from entering into the small flight experiment business. If NASA does wish to treat COMET as a commercial program, I would like to know more about how it plans to go about marketing this vehicle and what it plans to charge its customers.

A further step in this direction might be to establish a launch voucher program for researchers. I encourage NASA to look into the issue of launch vouchers. Such a program might provide a maximum number of flights for researchers while at the same time encouraging commercial space growth.

Thank you, Mr. Chairman.

[The prepared opening statement of Mr. Smith follows:]

OPENING STATEMENT BY REP. LAMAR SMITH
SUBCOMMITTEE ON SPACE
MARCH 5, 1991

Thank you, Mr. Chairman.

I am pleased that Mr. Rose is here from the Office of Commercial Programs, because I believe it is the commercial space industry that holds great promise for the future of U.S. competitiveness.

NASA's Centers for the Commercial Development of Space are especially valuable because of the university and industry research ties that are established.

Two of these Centers are located in Texas, one at the University of Houston, and one at Texas A&M.

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A further step in this direction might be to establish a launch voucher program for researchers. I encourage NASA to look into the issue of launch vouchers.

Such a program might provide a maximum number of flights for researchers while at the same time encouraging commercial space growth.

Thank you, Mr. Chairman.

QUESTIONS FOR JAMES ROSE, OFFICE OF COMMERCIAL PROGRAMS

1) Do you feel a launch voucher system might stimulate the commercial launch business?

_____

2) Do you feel a launch voucher system might save the government money and time in providing space flight opportunities for researchers?

Mr. HALL. Thank you.

I will give the audience the benefit of a remark I made, Mr. Sensenbrenner, that I sometimes not only don't write my own, I have trouble reading the one that they wrote for me. So I have some compassion for the gentleman's position.

Mr. SENSENBRENNER. That's why I got glasses last week, so that I could read it better. [Laughter.]

Mr. HALL. We have James Rose with us today. I think that we have an excellent witness, flanked by Frank Penaranda—did I say it correctly?—and Mr. Richard Ott. I think we might get the record really kicked off by me asking you, Jim, the first question I asked you when I met you earlier. Just give us the benefit, and for the record, of your background that brought you to this table.

Mr. ROSE. It's a long one.

Mr. HALL. Well, I think it's worth hearing because I was really impressed and interested in it.

Mr. ROSE. Well, I started my career with the NACA, which I think most people remember. I happened to arrive there about a year before it became NASA, so I will be able to get my wings when I retire from the old NACA. I was Engineer on Mercury. Gemini, became head of the Mission Planning Office on Gemini. In fact, I think I was really the first official engineer assigned to the program. We made the move to Texas to set up the Manned Spacecraft Center. And then I went to industry, spent ten years learning how McDonnell Douglas operated and was instrumental in some of their programs through Gemini Skylab. I returned to NASA with Mr. Yardley when he took over the Shuttle here in Office of Space Flight and was the Director of Engineering on Space Shuttle in that time frame, two years.

I went back to McDonnell to set up a new operation called Manufacturing Things in Space, and that gave rise to a commercial program at McDonnell with Johnson and Johnson, initiated in the 1978 time frame. Had the first joint endeavor with NASA in December of 1979. We flew seven flights aboard the Shuttle before Challenger went down. We had a major program underway to produce pharmaceutical product using the environment of space and a process called electrophoresis.

I was with this background when I came to NASA and assumed the duties of Assistant Administrator for the Office of Commercial Programs. That I have been in industry twice, I have been in the Government three times, I do believe I understand how they operate and what the needs are of both sectors, and I am trying to take that experience and put it together in a program that is not just one product and one process but a national program that will make the United States number one in the commercial development of space.

Mr. HALL. We won't subtract that from the time that we're going to allocate you to make your presentation. I thought it worthwhile to hear it. My, what a background.

Chairman Volkmer has just arrived, former chairman of the Space Subcommittee. We'd be glad to recognize you for any opening statement.

Mr. VOLKMER. I'm hear to listen to Jim.

Mr. HALL. All right. The Chair recognizes you, Mr. Rose.

STATEMENT OF JAMES T. ROSE, ASSISTANT ADMINISTRATOR, OFFICE OF COMMERCIAL PROGRAMS, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, ACCOMPANIED BY RICHARD H. OTT, DIRECTOR, COMMERCIAL DEVELOPMENT DIVISION, AND FRANK PENARANDA, DEPUTY ASSISTANT ADMINISTRATOR (PROGRAMS), OFFICE OF COMMERCIAL PROGRAMS

Mr. ROSE. Mr. Chairman and members of the subcommittee, I am pleased to be here to discuss what I think are exciting developments within NASA's Commercial Program. I would like to make a short statement and submit my written testimony for the record.

Mr. HALL. Without objection.

Mr. ROSE. The charter of the Office of Commercial Programs is to manage three specific program areas that I believe directly impact this country's ability to compete in the high technology global economy that we are dealing in.

Our Technology Utilization Program works to quickly transfer NASA technology to the private sector for secondary uses. Our ability to create new and innovative technologies that are useful to the Government and to small businesses through the Small Business Innovation Research Program contributes I believe directly to the U.S. international competitiveness position. And, third, in the long term, our ability to use the space frontier to develop new products and services can add a whole new dimension to this Nation's economic growth. It is imperative that we become number one in the commercial development of space and reap the benefits of this new environment.

I am going to speak first to the commercial space activities. It has been two years since I've had the opportunity to formerly address this subcommittee. Within those two years, we believe that we have made extraordinary progress. We can measure this progress by the interest in our programs by our competitors—the Japanese and ESA, specially—who are now trying to set up the similar type operations that we are carrying out at the present moment. We must continue the momentum and direction we have now taken in order to make sure we stay ahead of our friendly competitors.

Through the CCDS, the Centers for the Commercial Development of Space, we now have 238 companies and 72 universities that are collaborating in commercial space research. There are 59 patents in process. Seven companies have been spun off already in current commercial enterprise, and 44 technologies are now being used by their industry partners. Sixty-one technologies are now being pursued where space may show significant improvement. Sixty-four flight payload systems have been developed or are in process of being developed to support a 311 flight test program.

Up until now we've had two successful sounding rocket flights. The fabrication of a power vacuum deployable Wake Shield is on schedule and within cost and set for hopefully a launch in late 1992. The SPACEHAB contract has been signed. The COMET contractor is selected, two contracts signed, the third one will be signed on Thursday. EOCAP II contracts have been awarded to twelve new companies in the remote sensing field. A new sounding rocket called Joust will make its first flight for the CCDS Program

the end of this month, and that's provided by Orbital Sciences Corporation. Up till now there have been 39 flight tests accomplished since the return to flight following Challenger accident, and 24 flight tests are scheduled this year.

Now these are not random activities where NASA's doing odd things to help the industry. These are a well-organized, well-planned program with milestones and measures for tracking progress. The program consists of three phases in which the industry and Government roles are clearly understood and are currently meeting success.

The first phase, I call the technology phase. It is imperative that we must establish a technology base of understanding in areas that the industries of this country are interested in. If this technology base gets established, the advantages that space might offer in these 61 technological fields we've talked about will become apparent to the industry partners.

They, in turn, will then move into what I call phase II, which is the development phase of the program to carry out a development of this technology into an application. These types of development programs could run as lengthy as five years to get to a full application. But at some point we will, especially within the field of microgravity, we will begin to see true commercial operations I believe commence somewhere towards the latter part of this decade. Phase II I believe, where industry will begin to use the technologies the CCDS's are developing, we're looking to the 1993-1994 time frame to begin to see this really begin.

So right now we're in Phase I. Phase I not only consists of technology for products, which is ultra important—if you're going to commercialize space, we must have products and markets by the private sector; the Government cannot be the only customer. With those private end products, they will drive commercial transportation and infrastructure. And that brings all three elements of our space business into play—markets, transportation, infrastructure. And in the Phase I program, it is important that along with getting the technology base for markets and products, we're beginning to let the private sector commercially develop infrastructure and transportation so that these things progress simultaneously.

By mid-decade, we will have sufficient numbers of maturing systems and technologies and that we would intend to make a large use of the Space Station laboratories in order to continue to carry out this type of program.

The heart of the program, obviously, is the commercial centers, the Centers for the Commercial Development of Space. We asked them to do two things: leverage a broad industry base to develop product oriented technologies, and to also serve as an institutional base for helping to establish true commercial transportation and infrastructure activities. I have already told you some of the relationships they have, the numbers of industries involved; let me talk about how well the industries are supporting it from a financial viewpoint.

Last year, fiscal year 1990, the private sector and other Government—which could be State Governments or other institutions—their contribution to the CCDS upkeep in equivalent dollars was approximately $35 million, or 69 percent of the base support to

these CCDS centers. We're estimating that in 1991 that number is going to grow to $70 million, that's almost a doubling of the contributions coming from other than NASA sources, and that represents nearly 81 percent. So the trend is definitely in the right direction. If industry is putting money in or resources in to specific areas of technology they're interested in, they are not going to casually abandon these technologies without thoroughly looking at the potential. Because if they want to return any of their investment, they are going to have to have products to sell.

What's coming out of these centers. There are a few areas of promise I would just like to briefly sketch for you.

Value-added applications have been identified already in remote sensing fields, and eight developments in that field are already underway. And I believe within a couple of years we're going to see new markets and new systems of carrying forward using remote sensing information. These are value-added companies that will be operating here on Earth to do a variety of different things.

The use of the Wake Shield that the University of Houston is developing through a company called SII, Space Industries, Inc., in Houston. This Wake Shield will help us carry out epitaxial growth of thin films which, if it meets what we believe the capabilities can be achieved in space, these could produce semiconductors that will increase computational speeds as much as a factor of 100, and could help revolutionize again—put us back in the driver's seat in the United States in the field of fast computing speeds.

Protein crystals grown in space can be more accurately mapped on a molecular level, leading to ground development of new and improved drugs. Successful protein crystal experiments have been flown by CCDS affiliates Schering Plough, Merck, Vertex, Upjohn, DuPont, and Burroughs Welcome. The Schering Plough, Merck, and Vertex space grown crystals are much larger than any ever grown on earth to date. And what's more importantly, the resolution of these crystals are significantly higher, which means that they really are going to be an asset to the pharmaceutical world in producing new exotic products.

And the in the processing field, we are also able to study the effects of space on cells of human biological systems. Some examples of successes include Genentec, who is seeing results in their study of bone metabolism wound healing and the immune system. The Zeolites, zeolites is a product that have great potential in manufacturing medical refining and purification industries. Successful studies in this area have been carried out by Amoco and we're waiting to get into space to verify some of these studies.

These are just a few of the potential new products and services that might emerge. For these products to develop, it is important that the CCDS have timely access to space. The word "timely" is very important. Commerce, commercial world, time is critical. As part of our three phased program approach, NASA has defined a balanced flight plan that takes advantage of every opportunity for flight and, at the same time, develops or helps develop in the private sector transportation and infrastructure capabilities that can be marketed by U.S. firms worldwide.

The Wake Shield project, a required piece of infrastructure, is being developed in a totally commercial manner with a significant

reduction in cost and in half the time as compared with the standard Government procurement. In addition, this Wake Shield structure will be used as a carrier itself to carry other CCDS payloads that can be supported by that particular smart structure.

Of the 311 flights tests, requirements identified by the CCDS's, NASA is planning to accommodate 115 in the mid-deck of the Space Shuttle. In addition, 56 will be accommodated on commercially procured sounding rockets, and approximately 36 with getaway special with smart can type payloads in the payload bay.

The recently leased commercial mid-deck augmentation module—that's our generic name for it, it's called SPACEHAB—will accommodate some 81 flight tests, and the innovative COMET program will accommodate 23 of the flights that we must have in order to give us 30 days capability in space and return.

COMET is an important enterprise. Why? Because it is the first system commercially developed in the country that brings us a return capability of payloads in an automatic, unmanned mode. It is the only system of its kind in the Free World. The companies who bid and won the contract—two of them, by the way, are Texas companies, SII and SSI—they plan together with the third company, Westinghouse, to market the COMET program internationally starting this summer.

In other words, what is important about the COMET, the sounding rockets, and these other pieces—Wake Shield, for instance—is that we, the CCDS's, have a need. Because they have a need, we are letting these CCDS's procure these systems commercially, directly, without the Government involvement, without the Government specs, rules, and regulations. That's very important because if we're going to compete on a world market, this is the right approach; allowing these things to develop naturally in a commercial fashion. So we think these are all steps that not only satisfy the CCDS needs, but it puts American companies in position to market these services on an international basis and in the very near future.

I am going to switch now to the Technology Utilization Program. As stated before, NASA's Technology Transfer Program has generated over 30,000 secondary applications since the program began and are now contributing to the U.S. economy.

But NASA is continuing to work to make its Technology Utilization Program even better. We are establishing a National Technology Transfer Center in Wheeling, West Virginia, which will provide a national focus on technology transfer issues and needs—and I said national, not just NASA. We have been given the role of leadership to try to get a national center established which will become the focus of a revised TU network throughout the country.

As part of that, we are also going to restructure our Industrial Applications Centers, we call them IAC's, to bring them into the 1990s. The IAC's are user assistance centers whose job it is to provide information retrieval services and technical assistance to industry and Government clients. There are currently ten of the IAC's. We intend to broaden the geographical coverage of the network to include all the contiguous States in the U.S. by establishing a regional structure similar to the six Federal Laboratory Consortium regions. We are going to be in concert with that.

NASA is also expanding its outreach effort through NASA's own field centers to reach even more small businesses at the regional level.

I want to spend just a minute talking about the Marshall Center at Huntsville, Alabama, our center there. What they have done, they have established an impressive program by signing a technology transfer Memorandum of Understanding with the Governors of Alabama, Georgia, Mississippi, Louisiana, Tennessee, and West Virginia. Through this agreement, Marshall and the States are jointly conducting workshops and seminars in regions designated by the Governors. We are taking NASA technology as well as the knowledgeable scientists and engineers directly to small businesses at their location to help address their problems.

In addition, Marshall offers tours to the small businesses which allow these companies to meet face-to-face with developers of specific technologies to talk about these small companies' specific problems. For those businesses that cannot come to NASA, teams of State volunteers make site visits to the companies to help identify specific needs or problems. For example, in Warren County, Tennessee, 50 businesses were visited by State Evaluation Teams and approximately 70 problem-statements were generated.

The Marshall Center has established a Technical Action Panel to review each problem and refer it to the most likely source for technical resolution. If the capability does not exist within NASA to solve the problem, the Federal Laboratory Consortium is consulted. All 70 problems from Warren County, Tennessee, will be addressed.

To reach an even wider audience, Marshall is publishing some of these problems in their Center newsletter. And it is interesting, the newsletter gets a distribution not only of active employees but there are a lot of retirees in the area, and the retirees have time and suggestions and they are participating in helping to solve some of these problems. I think this is a very good example of the Federal Government teaming with States and the private sector to improve national productivity and enhance our competitiveness.

Now we'd like to see all of our field centers do something in a similar manner, so we're in the process of beginning to standardize things that we know are working.

Also, one other item. We did hold a Technology Transfer Conference here, the first of its kind, in Washington; we called it Technology 2000. It was held in November. It met every expectation we had. We had 2,400 in 10 days of which 75 percent were from industry. These were people who really wanted to talk to the NASA people who were here presenting 89 papers in the field of technologies being developed slanted towards the applications point of view. We think a lot was accomplished. For the first time I've been to a meeting, we weren't talking to the choir; we had people really working that wanted the information and wanted to participate. It was so successful that we're already planning Technology 2001, and we expect to triple the size of the attendance and of the display areas and other things. So we think what's important about that is that if you're going to transfer technology, do it fast. As soon as you can get industry thinking about the technologies that NASA has, the faster they're going to find applications, and this has to help us in our competitive search.

I've probably used my time, but just to briefly say the SBIR program is working very well within the Agency. Every one of our centers is pleased with the program, the quality of the technology being developed is excellent, and we're just beginning to measure the real progress of what we call the Phase III, where are there going to be commercial applications of what they've done in Phase I and Phase II. To this date, and it takes five years to go through the cycle, we're just beginning to see the results of the program from when it started, but some 88 products have already made it to the marketplace, new products that were derived from the work done in the SBIR Program.

And we do have one problem with the SBIR Program I would like to just bring up. On October 16, 1986, the program was reauthorized for five years with a sunset date of October 1, 1993, that's a little over two years. Because the SBIR program cycle lasts between three and four years, an orderly phase-out of the program must begin two years in advance of the specified sunset date. If the sunset date is not extended in February 1991, I mean, by the end of this fiscal year 1991, NASA must begin to reduce the number of Phase I projects this fall to allow funding for the Phase II, so that when we reach the sunset date, we will have the money to cover whatever is outstanding without having to ask for new appropriations. We would find this unfortunate. We need something—if the Congress cannot get to the bill this year to extend this thing, at least give us some type of a coverage, legal coverage, say don't slow the program down, which is probably going to happen. So that's the one issue I would like to bring to the attention of the subcommittee.

Mr. Chairman, that's my oral statement. I'm now ready to—we are, my colleagues—to try to answer any questions you might have.

[The prepared statement of Mr. Rose follows:]

Hold for Release Until
Presented by Witness
March 5, 1991

Statement of

James T. Rose
Assistant Administrator
Office of Commercial Programs
National Aeronautics and Space Administration

before the

Subcommittee on Space
Committee on Science, Space, and Technology
United States House of Representatives

NASA fosters and supports the commercial development of space in three ways. The first is as a developer of technology which will provide a well-spring of promising opportunities for commercial applications. The second is as a customer of commercial enterprise. Finally, through the Office of Commercial Programs (OCP), NASA "helps industry help itself" through more direct cooperation in selected areas. I am going to focus on the program of OCP, and will wrap up with a brief summary of the other two roles which permeate all of NASA's program offices.

The mission of OCP is to make commerce in space a reality by encouraging private investment in commercial space ventures and by facilitating commercial application of existing aeronautics and space technologies to United States industry. OCP's program encompasses a broad range of activities which fall into three categories: commercial use of space, technology utilization, and the Small Business Innovation Research Program.

COMMERCIAL USE OF SPACE: AN IMPLEMENTATION STRATEGY

For commercial enterprise in space to become a reality, a three-phased, process is expected. In each phase, the government role is very important, but different. The first phase of this process involves conducting research of technologies that could result in new products or services in the future, while at the same time building the necessary supporting transportation

capabilities and other infrastructure. Our nation is now in that first phase in most areas of the commercial development of space, and NASA is deeply involved.

Through its Centers for the Commercial Development of Space (CCDS) (consortia of government, industry, and academia that conduct research with potential commercial applications), NASA is using the grant program to ensure that a sound, market-driven technology base is being built by industry. To research adequately this technology base, CCDS's need access to space for testing their ideas and concepts. NASA is today providing some space in the middeck of the Space Shuttle for the CCDS's, but their planned experiments greatly exceed the capacity allocated.

NASA's strategy for providing a large portion of the CCDS's desired flight opportunities is to allow CCDS's to procure commercially the needed services from U.S. transportation and infrastructure industries. This plan allows CCDS's and their industrial partners to conduct research at a pace necessary for success, and also contributes to developing U.S. transportation and infrastructure companies. Not only will new products and services, now in the technology phase, be available for private, government, and international markets, but our transportation and infrastructure companies will also be in a position to compete globally for payloads.

During the second phase of this process, once a technology is proven to have potential commercial applications, it would then be developed by industry if industry saw sufficient economic return. However, today industry is still not in a position to do it alone because of the dependence on government space transportation and infrastructure. The government can play a very important role in this second phase through a unique government/industry collaboration called the Joint Endeavor Agreement (JEA). Under a JEA, private industry funds experiments, and the government provides the transportation and other services.

Also during this phase, the government must continue to pursue expanded infrastructure and transportation development to meet its own needs, and,

where appropriate, serve the needs of the private sector. The scope of such development projects are generally beyond what the private sector alone could support now, yet this infrastructure will be necessary if commercial development of space is to reach its full potential.

The final phase of the process, commercial applications, is primarily the responsibility of private enterprise. In this phase, technical applications are brought to the marketplace, providing income for individual companies, giving a boost to the U.S. economy, and improving our competitive position internationally. The private sector procures its own goods and services. The government role during this phase will be to provide access to infrastructure developed in previous phases. The government also can provide opportunities, under specified conditions, through the Space Systems Development Agreement (SSDA). The SSDA provides for an innovative "fly now-pay later" financing arrangement.

1. Highlights of Successful Initial Implementation Initiatives. Progress is being made in all areas. Highlights of some of NASA's accomplishments within the initial phase of the commercial space development process include the following:

a. A competition is planned for additional CCDS's in communications.

b. NASA's John C. Stennis Space Center's Earth Observations Commercialization Applications Program (EOCAP) represents a new approach to helping the remote sensing industry. The focus is not on technology development, but rather on business development. Twelve EOCAP II projects were selected on December 20, 1990.

c. OCP has awarded a $184.2 million fixed-price contract to SPACEHAB, Incorporated, to lease two-thirds of the available volume of the SPACEHAB Shuttle middeck augmentation module to support commercial and CCDS payloads.

d. The NASA-sponsored Commercial Experiment Transporter (COMET) was initiated this year by NASA's CCDS's this fiscal year. The COMET is a totally commercial transportation system that will launch CCDS experiments into low Earth orbit and recover them.

e. The Consortium for Materials Development in Space, a NASA CCDS, continued the sounding rocket program which was initiated in 1989, with the Consort 1 launch. Consort 3, successfully launched in May 1990 carried 12 major payloads and provided about 7 minutes of low gravity exposure.

f. A Memorandum of Understanding was signed with Technical and Administrative Services Corporation to provide a forum for the exchange of research information associated with closed environment systems related to food production both on Earth and in space.

g. CCDS's are planning and initiating a variety of hardware development projects to provide CCDS researchers with cost-effective, entirely commercial, means of conducting experiments in space. One such project, in its third year of development by the Space Vacuum Epitaxy Center at the University of Houston, is a "wake shield" facility for high vacuum materials research for use on the Space Shuttle.

2. Centers for the Commercial Development of Space (CCDS). The cornerstone of NASA's implementation strategy is the CCDS Program. CCDS's play a vital role in developing new commercial space industries. Through CCDS's, which have won accolades from both industry and academia, 189 companies and 62 universities have invested in commercial space research. The Centers move industrially driven emerging technologies from the laboratory to the marketplace with speed and efficiency by leveraging a broad range of research with commercial potential. The Program is intended to develop product-oriented technologies and stimulate commercial cost-effective transportation and infrastructure ventures. In FY 1991, NASA funding of the base grants comprises only 19 percent of the total funding for the CCDS Program; matching

funds from industry, university and other state and federal institutions will reach 81 percent (measured in cash and in-kind services). This represents a 100 percent growth rate over the 12-month period.

3. New CCDS In Communications. NASA has long contributed to the success of the highly visible and prosperous communication satellite industry. In 1992, NASA will launch the Advanced Communications Technology Satellite (ACTS). After the launch, NASA's efforts will be focused on forging stronger ties with industry as users of the satellite and on furthering communications technology development to maintain leadership in this lucrative field.

Given the highly competitive nature of the telecommunications industry, both domestically and internationally, it is essential that decisions regarding development of new technologies for telecommunications services are responsive to industry-determined needs. It is also imperative that the movement of technology from the research laboratory into operational service is accelerated.

The CCDS Program is a proven vehicle for accomplishing both of these goals. NASA is, therefore, transferring responsibility for the ACTS experiments program and advanced communications satellite technology development from the Office of Space Science and Applications (OSSA) to OCP. OCP will establish, through open competition, one or more CCDS's to create the infrastructure for infusing NASA's technology advances into the satellite-based telecommunications industry, including participation in the ACTS experiments program.

4. Earth Observations Commercialization Applications Program (EOCAP). On December 20, 1990, NASA announced the selection of 12 additional research projects to develop new commercial applications of space-based and airborne remote sensing technologies. NASA's funding of these projects is a continuation of EOCAP which is implemented by OCP. The objective of EOCAP is to identify and research new products and services that might be commercially applied based on NASA-developed technology for gathering and analyzing Earth and ocean resources data through remote satellite or aircraft observations.

OCP manages EOCAP through the Science and Technology Laboratory at NASA's John C. Stennis Space Center in Mississippi.

OCP and OSSA plan to fund over $2 million of research annually under EOCAP. Participating private firms are required to provide co-funding of this research. The first solicitation for proposals under EOCAP was issued in late 1987. Nine projects, which began in 1988 termed "EOCAP I", selected from the more than 120 proposals received under this first solicitation, are currently being funded. The second solicitation for proposals, issued in June 1990, resulted in 50 proposals. Twelve of these proposed projects, termed "EOCAP II", were selected for negotiation leading to 1-year funding contracts, with options to extend funding for an additional 2 years.

The following commercial research areas that the 12 winning private entities will undertake as part of EOCAP II are:

- Hazardous Waste Detection
- Improved Urban Infrastructure Mapping for Market Forecasting
- Land Use and Cover Change Analysis Systems
- Integrated Software Systems for Analyzing Remote Sensing Data
- Application of Remote Sensing Technology for Real Time Disaster Assessment
- Improvement of Hydrologic Forecasting
- Oil Seep Surveys
- GeoStack Data Base for Geographic Information Systems
- Pipeline Infrastructure Monitoring and Management
- North Pacific Fisheries Development and Management
- Agricultural Production Management
- Wetlands Information Services

The EOCAP I projects have resulted in working relationships among nearly 100 private firms and public interest groups in a multitude of states. A summary regarding the successes of the EOCAP I projects, to date, is as follows:

a. Resulting commercial technology played a major role in mapping of the Alaska oil spill.

b. A low cost commercial system was developed to acquire ocean transportation and fishing data.

c. Two foreign countries are currently engaged in discussions with EOCAP grantees regarding conservation of cultural and natural resources in an extremely fragile environment.

d. The use of EOCAP potato crop assessment maps was commercially extended to other high value vegetable crops.

e. A very innovative educational extension service for forestry users was established.

f. The sales of EOCAP commercial software packages are currently meeting market projections.

g. New corporate profit centers have been established to provide services regarding mapping and monitoring of transportation and pipeline infrastructure.

h. A new system to monitor and predict movement of arctic ice was developed for marine and offshore drilling operator clients.

i. A commercial aircraft scanner was developed to acquire specialized ocean color data for fisheries assessment.

5. CCDS Spinoff Companies: One Measure of Success. We are very pleased to report that there are now seven spinoff companies from the CCDS's. Last year,

I brought BioCryst to the Committee's attention. It is a pharmaceutical company in Birmingham, Alabama, doing work in X-ray crystallography and computerized molecular modelling to develop new pharmaceutical compounds. Their work was done in cooperation with the Center for Macromolecular Crystallography, University of Alabama-Birmingham.

Orbital Technologies Corporation grew out of work performed at the Wisconsin Center for Space Automation and Robotics (WCSAR) at the University of Wisconsin in Madison. Its mission is to develop and market spinoff products from the space program as well as offer commercial products and services for space development projects.

Quantum Devices, Incorporated, also evolved out of WCSAR. Its mission is to find commercial applications for solid-state light emitting diodes as a source for plant growth irradiation in space.

The Space Remote Sensing Center formed a new company, Digital Visions, in Jackson, Mississippi, to provide a mechanism for transferring remote sensing applications into a private, for-profit mode of operations.

Insight Scientific, Incorporated, of Simi Valley, California, is a spin-off company from the Center for Commercial Crystal Growth in Space at Clarkson University. It manufactures transparent furnaces which enable visual contact with crystals during formation.

Quantum Controls is marketing, under license from the Space Vacuum Epitaxy Center (SVEC) at the University of Houston, an innovative approach to thin film growth quality determination. The company was formed for the purpose of developing thin film growth analysis and growth control technology.

Epitaxy Growth Services is marketing, also under license from SVEC, software and hardware developed in SVEC for analysis of thin film growth quality. The system provides a video-based software analysis of electron diffraction data from growing thin films.

6. Additional Signs of Success. NASA is also establishing an intellectual infrastructure for space commerce by involving a number of professors and students in the CCDS work. Currently there are 225 professors, 120 doctorates and post doctorates, 352 graduate students, and 127 undergraduates. In addition, 214 students who have worked on CCDS projects have been awarded degrees and 149 of them are working in the private sector in space technology disciplines.

OCP-sponsored CCDS's have pursued a vigorous plan of ground and flight testing on commercial space technologies. There have been 1,089 drop tube/drop tower experiments completed, 81 Lear/KC-135 flights tests, 19 sounding rocket flight tests, and 10 Space Shuttle flight tests since September 1988. In addition, OCP and the CCDS's have 64 hardware systems under development for flight tests.

7. Developing Transportation/Flight Requirements Planning. Extensive ground tests by CCDS's have shown the need for spaceflight testing on 61 different technologies identified by CCDS's as having commercial potential. Before a decision can be made on whether a technology is commercially viable, a certain number of flight tests must be conducted. The process of testing and retesting is done with constant industry interaction to determine commercial potential throughout the entire ground and flight testing phases. With current flight plans, we believe the maturation of these technologies will occur between this year and 1996.

Transportation planning has determined that 311 flight tests will be required to mature the 61 technologies over this period. OCP planning, using NASA's last published secondary manifest, indicates 115 of these requirements will be accommodated in the middeck of the Space Shuttle. The recently leased Commercial Middeck Augmentation Module (SPACEHAB) will accommodate 81 flight tests. NASA plans to fly 23 on COMET, and 56 on sounding rockets. There are approximately 36 "Get-Away Special" type of payloads planned.

8. Commercial Middeck Augmentation Module: SPACEHAB. In December 1990, NASA awarded a contract to SPACEHAB, Incorporated, to provide the services of a

commercial middeck augmentation module. The firm fixed-price contract leases two-thirds of the pressurized SPACEHAB module's capacity over its first six flights. These flights will cover a 5-year period planned to begin in late 1992. OCP will then make that capacity, equal to about 200 Space Shuttle middeck lockers, available to U.S. private entities for commercial research initiatives. The total amount of the contract is $184.2 million. Under the contract, SPACEHAB will provide physical and operational integration of the module with the commercial experiments to be flown, power, cooling, data management, and crew training. In addition to this NASA commitment, SPACEHAB has leased to non-U.S. Government customers an additional 12 percent of its total capacity over these initial six flights.

NASA's need for the contracted amount of SPACEHAB capacity is the result of NASA's support the commercial development of space. Accordingly, OCP provides Space Shuttle-based commercial research opportunities through its grant program for the CCDS's, as well as through its JEA Program. Approximately 61 different technologies requiring more than 300 flights of middeck locker capacity are currently being developed by the NASA-supported CCDS's. Other users sponsored under OCP who have near-term middeck locker flight requirements include 3M and Boeing. These commercial experiments to be flown are targeted to possible breakthrough technologies in areas such as protein crystal growth, zeolite crystal growth, polymers, fluid dynamics, bioprocessing, physiology, and plant growth.

9. COMmercial Experiment Transporter (COMET). Early this year, NASA's Center for Advanced Space Propulsion (CASP), at the University of Tennessee, began unfolding plans for a commercially developed unmanned system for the launching and recovering of commercial space-borne experiments. This newly devised system, called the COMET, is seen as an initial step toward the establishment of an entirely new U.S. industry. Due to the use of the COMET system, commercial payloads gain primary payload status, therefore enabling NASA to quickly meet commercial requirements. In addition, because CASP is handling the procurement, the service can be purchased commercially. The spacecraft itself will provide the long-term microgravity environment needed by some payloads, particularly those involving protein crystal growth experiments.

Projected into space by an expendable launch vehicle (ELV), the COMET free-flyer will contain both a service module and a recovery system. Payloads will be aboard both components. After a month in orbit, the recovery system will separate from the free-flyer and return to Earth to be retrieved at a location in the southwestern United States. Following the recovery system's reentry, the service module continues to support other nonrecoverable experiments for 100 days or more in space.

CCDS's will be totally responsible for system-design, fabrication, test, launch, and operations of COMET in which industry will be encouraged to be innovative. Fourteen firms submitted 15 proposals in the competition to develop COMET. On January 28, 1991, it was announced that CASP had come to a final decision on its selection of three industrial firms that will be responsible for establishing launch and recovery of the COMET space system. The contractors selected include Space Industries, Incorporated, responsible for payload integration, orbital operations and recovery system and services; Space Services, Incorporated (SSI), who will provide for the launch vehicle and services (based on its Conestoga rocket); and Westinghouse Electric Company, whose obligations include systems engineering and the service module. Upon completion of contract negotiations by CASP, the contracts will be prepared for inclusion in the CCDS grant by NASA with the budgeted $10.5 million in 1991 as initial funding. These three firms will then work in close collaboration with seven of NASA's CCDS's assigned to the project. It is expected that the entire launch effort will take 18 months, leading to a projected launch date of September 1992.

10. Sounding Rockets Program. In March 1989, the Consortium for Materials Development in Space, a CCDS, successfully launched six CCDS-developed payloads on an SSI sounding rocket, Starfire. Eight members of U.S. industry, two other CCDS's, and three other universities were involved in the project. The suborbital flight, named Consort 1, provided 7 minutes of microgravity.

A second commercial launch, the Consort 2, experienced a second-stage guidance failure within seconds after lift-off in November 1989. Safety personnel were forced to destroy the booster, but the payload module was parachuted to safety

and was recovered undamaged. Consort 3, the reflight of Consort 2, was successfully launched in May 1990. It carried 12 major payloads and provided about 7 minutes of low gravity exposure.

Because of the success of the sounding rocket program, it was augmented last year to provide larger sounding rockets that will, in turn, lengthen payload exposure to the microgravity environment. Space Data Corporation, a wholly owned operating division of Orbital Sciences Corporation, has developed the Prospector vehicle which will launch a sounding rocket mission, Joust-1, whose first launch is scheduled for March 1991, and will provide approximately 14 minutes of microgravity.

11. Commercial Development of Infrastructure: The Wake Shield Facility. With the Wake Shield project, the Space Vacuum Epitaxy Center (SVEC) at the University of Houston, Texas, has devised a timely, low-cost approach to processing high-quality materials processing in the high vacuum of space. Using the ultra-vacuum of space, the facility has been designed to avoid the problem of contamination resulting from Earth-based experimentation and improve the growth conditions for thin films. Superior thin films, an important element in the production of semiconducting and superconducting materials, could greatly enhance computers, communications, and sensor systems.

SVEC and its industrial partners are implementing the Wake Shield project with a commercial approach that is expected to reduce the overall cost to NASA and improve manifesting options. Though the project was initiated as recently as 1989, the payload is being readied for flight as early as late 1992, even though the configuration has been changed from an attached to a free-flyer mode. A launch date for the first total commercially sponsored flight has been targeted for 1996. Industry will fund the hardware upgrades and refurbishment, assembly, test, Space Shuttle integration, and operations, and NASA will fund launch costs and optional services.

To date, the Wake Shield Facility Program is progressing as scheduled. Design, fabrication, component testing, and procurement activities are nearing completion, and the facility is currently undergoing assembly and checkout. System integration will begin at the end of 1991.

COMMERCIAL USE OF SPACE BUDGET REQUEST

NASA's FY 1992 budget request of $118 million for Commercial Use of Space will be used to fund work in three major categories: Transportation, Commercial Applications and Enhancements, and Commercial Development Support. The largest portion of this request ($70.5 million) is to provide transportation to space for CCDS payloads which will help U.S. transportation and infrastructure companies develop. The FY 1992 budget request for commercial use of space is essential to keep the current momentum going.

The Commercial Applications Research and Development (R&D) budget request for $40.8 million will be used to continue funding of CCDS's, and to increase flight readiness in response to industry identified flight and hardware requirements. Of this request, $3.9 million is for increasing integration costs resulting from the increased CCDS flight activity. The Commercial Applications R&D budget also includes $3.0 million for the Wake Shield Facility which was funded last year through the Construction of Facilities (CoF) budget. We believe, however, that although "Facility" appears in the title, the Wake Shield is a piece of flight hardware, and, as such, does not belong in the CoF appropriation. We are also requesting an augmentation of $3 million in FY 1992 for continuation of EOCAP.

The remainder of the budget request, $6.7 million, is for Commercial Development Support to provide analyses and provide private sector coordination and feedback necessary to the Program.

The requested $118 million will establish a solid foundation upon which to accomplish our nation's commercial development of space goals.

TECHNOLOGY UTILIZATION (TU)

By their challenging nature, NASA R&D programs are especially productive in technology advancements. This wealth of technology is an important national asset in that it can be reused to develop new products and processes, increased productivity, new companies, and new jobs -- resulting in expanded benefit to the U.S. economy.

1. Highlights of FY 1990 Accomplishments. Some of the more important accomplishments that have occurred in the TU Program this past year include the following:

a. Reports of new technology resulting from NASA and NASA contractor R&D programs exceeded 1,500 for the first time in 10 years.

b. Industrial subscribers to ***NASA Tech Briefs*** grew to an all-time high of 200,000 nationwide.

c. An international edition of ***NASA Tech Briefs*** has been approved.

d. The baseline program planning and definition of the National Technology Transfer Center (NTTC) was completed with the cooperation of the Federal Laboratory Consortium (FLC).

e. TECHNOLOGY 2000, the first national conference and exhibition of NASA's technology for transfer to industry, was held and was a resounding success.

f. Phase I installation of the Technology Utilization Network System was completed. This system will enhance new technology acquisition and provide NASA with a telecommunications network for technology transfer.

g. Preliminary planning was completed for the restructuring of NASA's nationwide Industrial Applications Center network.

h. Phase I planning and definition of the AdaNET Program was completed. Efforts are now focused on development of Ada software products and services for industry.

2. Technology Dissemination. An essential ingredient in promoting greater use of NASA technology is creating a broad awareness among potential users of new NASA-developed technology available for transfer. This is accomplished primarily through the ***NASA Tech Briefs*** publication. Each issue contains information on newly developed products and processes, advances in basic and applied research, improvements in shop and laboratory techniques, new sources of technical data and computer programs, and other innovations developed by NASA field installations or NASA contractors. ***NASA Tech Briefs*** is commercially published and now reaches more than 200,000 subscribers per year. Since 1963, more than 17,000 innovations have been published as tech briefs. Firms interested in a particular innovation may get more detailed information by requesting a Technical Support Package. More than 120,000 such requests are generated annually.

NASA's ***Spinoff*** magazine continues to report NASA technology transfer efforts to the public. Nearly 700 examples of successfully transferred technology have been highlighted in the publication between 1976 and 1989. In all, NASA's advancements in virtually every scientific and technological discipline have generated over 30,000 spinoffs to industry and government.

3. Technology 2000. On November 27 and 28, 1990, NASA held its first annual technology transfer conference and exhibition, Technology 2000. Sponsored jointly by NASA, ***NASA Tech Briefs*** and the Technology Utilization Foundation, the purpose of the conference was to generate awareness of NASA technology and technology transfer mechanisms among many sectors of U.S. industry. In terms of program content, quantity, and quality of exhibits, attendance, media coverage, and attendee and exhibitor satisfaction, the conference was a resounding success and will become the bench mark against which all future efforts will be measured.

Over 160 companies, universities, technical societies, state technology transfer offices, and government research centers were represented in 175 booths occupying some 15,000 square feet of exhibit space. More than two dozen NASA technology spinoffs were demonstrated in the exhibit hall. Of the 2,469 attendees, 75 percent were from industry, 15 percent government, and 10 percent university. Industry attendees were typically top-level decision-makers from virtually every sector of business.

Planning for Technology 2001 has already begun. Over 40 firms have submitted applications to exhibit at the Technology 2001 conference and exhibition to be held in San Jose, California, in early December 1991. This year, NASA plans to invite other federal agencies and laboratories to participate. If successful, this NASA-sponsored conference could become a major event to promote technology transfer throughout the Federal Government.

4. Technology Applications. Another important facet of NASA's TU Program is its technology applications projects. These projects apply NASA technology and expertise to redesign and re-engineer existing aerospace technology to solve problems of national scope and significance in both the public and private sector of the U.S. economy.

A measure of recent applications program successes include the following examples:

a. The signing of a Space Act agreement with Air Products & Chemicals, Incorporated, in Allentown, Pennsylvania, to apply NASA-developed diamond-like coatings for corrective lenses.

b. The granting of a license to Knowledge Resolution, Incorporated, of Texas, to market artificial intelligence-based physics tutoring software to the educational community.

c. The commercial marketing of a noninvasive burn-depth analysis instrument by Westminster FDI, Incorporated. This instrument was derived from NASA ultrasonic technology advancements.

In general, NASA field installations engage in nearly 60 active applications projects each year. Examples of currently active projects include the following:

a. An exciting new development of a low temperature eximer laser for use in certain angioplasty procedures. The eximer laser does not damage blood vessel walls and offers nonsurgical cleansing of clogged arteries with extraordinary precision. The system is the Dymer 200+ Eximer Laser Angioplasty System and is developed and produced by Advanced Interventional Systems, Incorporated, of Irvine, California. The Dymer 200+ is based on NASA-patented technology developed at NASA's Jet Propulsion Laboratory, Pasadena, California, for satellite-based atmospheric studies.

b. A highly accurate, reliable ice detection system utilizing the latest advances in ultrasonics. Looking for improved safety from aircraft icing, Simmonds Precision Products, Incorporated, a subsidiary of Hercules Incorporated located at Vergennes, Vermont, undertook to develop this highly reliable system. The Simmonds Precision system is based on technology developed under a NASA grant by researchers at Massachusetts Institute of Technology (MIT) and through wind tunnel and in-flight tests of the MIT-eveloped system at NASA's Lewis Research Center at Cleveland, Ohio. Simmonds Precision is producing the system under a patent license from MIT.

c. A commercially available image processing software package that allows motion measurement of images on a personal computer. The software is IMAGELAB FFT and is derived from NASA Ames Research Center, Mountain View, California, velocimetry technology. The package is marketed by Werner Frei Associates, Venice California. IMAGELAB FFT is a general purpose image processing software with a variety of applications. Among them are image enhancement of fingerprints and analysis of videos taken during robberies in use by bank and law enforcement agencies.

5. Industrial Applications Centers (IAC). To promote the transfer of aerospace technology, NASA operates a number of user assistance centers whose job is to provide information retrieval services and technical assistance to industrial and government clients. There are currently ten IAC's affiliated with universities across the country. NASA is currently restructuring the IAC network to improve network performance and service. These efforts to upgrade and revitalize the IAC network are based on several factors which have emerged in recent years:

a. An increased interest by local and state governments in technology for economic development.

b. Broader and more active programs in technology transfer among all federal agencies and laboratories.

c. The rapid growth and evolution of information transfer and communications technology.

NASA's approach to restructure the current network is intended to accomplish several objectives:

a. Broaden the geographical coverage of the network to include all the contiguous states in the U.S. by establishing a regional structure similar to the six FLC regions.

b. Eliminate size and functional disparity among current IAC's by funding each new IAC equally -- about $1 million per year.

c. Form linkages with state and local government technology transfer activities/programs to leverage NASA's resources and avoid unnecessary competition and duplication of effort.

d. Include all federal laboratories within FLC in our technology transfer effort.

d. Establish close ties with the CCDS's in their respective regions, as their technology "marketing agent."

e. Provide a more uniform level of "full-spectrum" services by all of the network participants.

f. Encourage partnerships or consortia of universities and state organizations within a designated region to represent that region as one of the new "IAC's."

g. Establish more realistic performance criteria for regional centers emphasizing technology transfer results, rather than process performance.

As with the current IAC's, the new regional centers will use NASA funds to support their institutional base and operations. They will generate client income with which to expand their services and client base. Their regional focus will, hopefully, align them closer to the needs of particular industries, local businesses, and entrepreneurs. By establishing a "presence" in each state in their respective regions, they will be able to reach out to prospective clients and market federally developed technology more effectively.

The new IAC's will be selected through a full and open competition beginning this coming spring. It is anticipated that the new IAC's will begin operations in January 1992.

6. National Technology Transfer Center (NTTC). In report language accompanying NASA's FY 1990 appropriations bill (P.L. 101-144), the Congress directed NASA to "initiate and establish" NTTC at Wheeling Jesuit College in Wheeling, West Virginia. This direction was based on an NTTC Preliminary Definition/Design Study reported to Congress by NASA in FY 1989. Accordingly, in March 1990, the research and planning phase of the program was initiated at Wheeling Jesuit College under a NASA grant.

The NTTC research and planning activities initially focused on regional and national studies to support the implementation phase of the program scheduled to begin in May 1991. To achieve broad-based support and participation by all government laboratories, for this national center, a special FLC task group was formed to assist NASA and Wheeling Jesuit College in this program definition and planning effort.

The baseline planning activity centered upon the formulation of program goals, function requirements, and operating parameters for a 5-year program to fully establish NTTC. It should be noted that NTTC is intended to be self-sustaining at the end of this period.

7. AdaNET Program. The AdaNET Program is designed to transfer existing and emerging Ada software and software engineering technology from the Federal Government to the private sector through information-sharing, repository, and referral services and networks. During calendar year 1990, Phase I of the AdaNET Program was completed and Phase II began. Phase I consisted of the development of a prototype software engineering computer network and information service known as AdaNET Service Version 2 (ASV2); operation and analysis of ASV2 with a national community of users; and the acquisition and cataloging of ASV2 with information from public software engineering components from the Army, NASA, and other government and commercial sources. During Phase I, technical and management capabilities were strengthened through industry team-building, software engineering market research and analysis, and related technology transfer activities.

AdaNET Phase II, presently underway, is directed toward the operation and deployment of AdaNET services to increase the availability of reusable software components and associated software engineering technology, as well as research and technology to enhance operational systems. During Phase II, AdaNET should be able to demonstrate a tangible return on investment for NASA through software engineering reuse and technology transfer, and should be able to enter into revenue producing service relationships with external organizations. To understand the requirements of the user communities, AdaNET continues to survey and analyze its consumers and engage professional and

academic organizations through conferences and appropriate forums. Additionally, during Phase II, AdaNET will form a steering committee comprised of industry, academic, and government representatives.

TECHNOLOGY UTILIZATION BUDGET REQUEST

The FY 1992 budget request for TU is $32 million. Of this $32 million request, $11 million is to support NTTC and AdaNET development under the Civil Systems budget line. The $8 million within the Technology Dissemination element will be used to expand and restructure the IAC network and to form stronger links with federal and state technology transfer activities. Under Technology Evaluation and Applications, NASA is seeking $13 million to strengthen the technology applications program at our field installations and to provide the field installations with needed resources to gather, report, and document all advanced technologies emerging from NASA's R&D programs.

A SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM

Since 1983, the SBIR Program has proved its value both to NASA and the high technology small business community. The Program, funded by a 1.25 percent set-aside from the annual NASA R&D budget appropriation, has increased small business participation in NASA's R&D activities and provided entrepreneurial firms the opportunity to develop and market innovative commercial products. Since the beginning of the program in 1983, NASA has made more than 2,200 SBIR contract awards to almost 770 small businesses.

SBIR is structured in three phases. Phase I is a short, 6-month effort by small businesses to determine the feasibility of technically attractive and potentially useful innovations they propose in response to the annual SBIR Program Solicitation. Competitively selected, Phase I contracts are typically funded at $50,000 and run 6 months. On completing their research, successful Phase I contractors are invited to submit proposals for further development of their innovations in Phase II programs costing up to $500,000 lasting up to 2 years. Since 1983, more than 1,500 Phase I projects have been funded (281

in 1990) and more than 630 have proceeded thus far into Phase II. More than half of all completed Phase I projects each year are selected competitively for Phase II continuations.

Phase III, though not funded out of the R&D budget set-aside for SBIR, provides two opportunities for small businesses. One of these is for final development and procurement of the Phase II product or process for use by the government. However, of equal and sometimes greater importance, Phase III can also provide the small business an opportunity for developing commercial applications of the research using private sector capital.

NASA's assessments of Phase III success over the past 3 years indicate that at least 25 percent of the SBIR projects that have completed Phase II have already led to commercial applications, and that more than half the Phase II project results are already used, or will be used by NASA in our many programs. Thus, the fruits of the SBIR Program benefit not only NASA but also private industry and the entire economy. Furthermore, NASA has been pleased to find that the quality of most of the research projects conducted by small businesses under SBIR contracts is very high -- equal to or better than comparable research in other parts of the NASA program.

Based on recent information provided by 61 of 250 SBIR Phase II contractors queried, at least 88 products resulting from NASA SBIR Phase II projects have entered commercial markets or have current or planned application by NASA. To illustrate, several important SBIR project applications include the following examples:

a. Photosynthesis Measurement Instrument. An underwater photosynthesis profiler was developed under SBIR by Biospherical Instruments, Incorporated, of San Diego, California. A NASA application is validation of satellite sensor measurements, while in its commercial applications, the device is being used to monitor conditions in fisheries, water treatment plants, and reservoirs.

b. Remote Sensor System for Fisheries. In another aquatic project, Daedalus Enterprises, Incorporated, of Ann Arbor, Michigan is completing development of commercial remote sensing systems for the fisheries industries based on its SBIR research. These systems, which will be marketed in 1991, will help the industry deploy their fleets more efficiently in waters that have high concentrations of marine life.

c. Stirling-Cycle Refrigerators. Successful development of coolers for instruments aboard spacecraft led the way for the Stirling Technology Company, of Richland, Washington, to develop a fluorocarbon-free refrigerator for domestic use. Assistance in the domestic application was provided by the Department of Energy.

d. Velocity Meters. Macrodyne, Incorporated, of Clifton Park, New York, developed technology for NASA uses in laser velocity meters for wind tunnels and jet engines. Now, a commercial application of the technology provides a means for accurate measurement and control of the rate at which aluminum sheet is being produced in high-speed rolling mills.

e. Industrial Robots. A highly flexible, robot-wrist mechanism developed for NASA under SBIR by Ross-Hime Designs, Incorporated, of Minneapolis, Minnesota, has been applied to commercial products by a major supplier of industrial robots. Initial commercial applications are robotic painting and spray finishing.

f. Laser Devices. Lightwave Electronics Corporation, of Mountain View, California, has sold some 400 ultra-narrow line-width lasers based on SBIR technology. Commercial applications of these devices include fiber sensing, communication, and infrared interferometry.

g. Processes and Services. In addition to many end-item products resulting from SBIR projects, several small companies have developed processing facilities through which they now provide services and basic materials to a wide range of industries. For example: the Spire Corporation of Bedford, Massachusetts, now has capabilities to supply several new types of

semiconductor materials for use by electronics firms; Scientific Materials Corporation of Bozeman, Montana, sells extremely pure crystals for use in solid-state lasers; APA Optics of Minneapolis, Minnesota, supplies computer-generated holograms to a wide variety of clients for use in commercial applications and provides opto-electronic materials to many corporations through its Opto-Electronic Materials Foundry. The list is far from complete. New products and processes derived from the NASA SBIR Program are being added continuously.

New SBIR Initiatives

To stimulate the interest of potential customers and markets and to encourage private contracts with small firms that have commercially viable products, in late 1990, the SBIR Office published a catalog listing detailed information on the 88 products that have resulted from SBIR contracts. Several of these were noted previously. Thus far, more than 1,500 copies of the catalog have been distributed through mailings and at the Technology 2000 conference which was held in Washington, DC, in November 1990.

In addition, the SBIR Office is working to include these products in the data base network of NASA's IAC's. The New England Research Applications Center, in Tolland, Connecticut, has already integrated information on SBIR products in its data base system.

As part of its outreach program, the SBIR Office sent representatives to 16 conferences held last year by federal and state agencies and small business development organizations across the United States. The Office plans to participate in at least two scheduled federal hi-tech conferences in 1991 and in other regional and state small business seminars.

Because of concerns over the nation's industrial competitiveness, NASA's SBIR Program is increasing its emphasis on selecting more projects that have potential commercial application in addition to NASA's research requirements.

NASA AS A CUSTOMER OF THE PRIVATE SECTOR

NASA and NASA-funded activities strive to utilize commercially available space products and services to the fullest extent feasible. Examples of this include communications satellites and ELV services. NASA may also enter into contracts, such as anchor tenancy, to reduce the upfront risk when there are existing or potential non-U.S. Government customers and private capital is at risk. Two examples are the Ocean Colar Data Procurement and SPACEHAB.

NASA is currently in the process of procuring ocean color data through a 5-year commercial contract called Ocean Colar Data Procurement. Rather than own the satellite, NASA will purchase data generated by the satellite from the private sector owner who can commercially market its services. The fisheries industry has already expressed interest in obtaining ocean color data for locating underwater fishery habitats.

SUMMARY AND CONCLUSION

We are justifiably proud of the progress in space commerce during the past year. American businesses are looking to space for new opportunities and as new fields of space commerce develop, the resultant new products and services will create increased demand for launch services and related infrastructure. These industries not only will create employment and generate revenues and taxes, but can also have a significant positive impact on our nation's competitive posture in a global economy.

NASA has initiated approaches to developing private sector applications of space technology and access which are moving technology into the marketplace, building new bridges among government, industry, and academia, taking increasing advantage of access to space, and yielding lessons which may well have far-reaching implications for non-NASA environments.

These approaches take several forms beyond the development of technology. First, CCDS's have resulted in close team work among industry, academia, and government sectors, as well as strategic private sector investment in a wide

range of promising space technology disciplines (automation, remote sensing, life sciences, materials processing, power, propulsion, and structures). Progress is being made in maturing technologies, new spinoff companies have been formed, numerous flight experiments have been manifested, and new private sector support capabilities are being created in space transportation and infrastructure.

Second, our organized approach to technology transfer of aeronautics and space technology to nonaerospace industries, using our network of readily accessible IAC's, has resulted in thousands of beneficial spinoffs -- some 30,000 applications, and economic benefits amounting to tens of billions of dollars -- measurable return on the NASA investment.

We thank you for your past support of our program and hope for your continued vote of confidence.

Mr. HALL. Thank you very much, Mr. Rose.

We have in attendance Tom Lewis. Congressman Lewis, we would recognize you for any statement that you'd want to make.

Mr. LEWIS. I have no statement.

Mr. HALL. All right.

Mr. Cramer, Congressman Cramer.

Mr. CRAMER. Mr. Chairman, if I could take just a brief minute. I've noticed that this budget does contain substantial increases in the funding for the centers. And I want to tell you that I support that increased funding. I'm from Huntsville, Alabama.

On page 11 of your statement here, you point out one of our centers—there are three centers located in Alabama, UAH has a very successful one, the center there through its Consortium for Materials Development in Space. And together with your office and the local industry there, we've developed a Consort I, which was the first low G materials processing payload to be launched by a commercially licensed rocket in the United States. And I think this particular success demonstrates the ability of that consortium of industry, of the University center there, and Government agencies to rapidly prepare and launch payloads; and it is considered a milestone in the evolution of commercial launch services in the United States. I would hope that you would review, as I know you already have, the success of the programs there at UAH and use it as model. We would hope that it could be a model for the rest of the country. So I applaud there.

Mr. Chairman, that's just a brief statement. I would like to submit a more detailed statement for the record.

Mr. HALL. You certainly may do so.

[The prepared opening statement of Mr. Cramer follows:]

OPENING STATEMENT-CONGRESSMAN BUD CRAMER
SPACE SUBCOMMITTEE AUTHORIZATION HEARING
COMMERCIAL PROGRAMS AND SPACE OPERATIONS
MARCH 5, 1991

Mr. Chairman, the State of Alabama is proud to play a leading role in the commercial development of space. NASA, through its Office of Commercial Programs, has established 16 Centers for the Commercial Development of Space. This program is designed to promote the interaction and cooperation of industry, academia, and government in commercial product development in space. Three Centers are located in Alabama; at Auburn University, the University of Alabama in Birmingham, and in my District at the University of Alabama in Huntsville(UAH).

The Center located at UAH is of particular interest to our efforts to commercialize space. The Consortium for Materials Development in Space, the Center at UAH, is leading the way in developing space as an experimental facility for materials research. The research being conducted at UAH through the Consortium may someday lead to the realization of "space factories" to manufacture perfect or near-perfect materials in zero gravity.

The UAH Consortium is an outstanding example of the cooperative spirit of the CCDS program. Local industry participates in the Consortium and some of the members include Boeing Aerospace, Deere & Company, Frontier Research, IBM, Instrumentation Technology Associates, McDonnell Douglas Huntsville, Teledyne Brown, Thiokol, and Wyle Laboratories. Since we are scrutinizing the participation of industry in the CCDS program, the UAH Center can be taken as a shining example of how the program should and can operate and should be a model for other programs throughout the country

UAH continues to be a pacesetter in materials research. In 1989 UAH sponsored the flight of Consort I, the first privately launched commercially licensed rocket flight in the United States to carry a materials processing experiment into the low gravity of space. Consort I was an unqualified success. All six experiments returned with useful data and processed materials which are under analysis. The success of Consort I has been hailed as a milestone in the evolution of commercial launch services in the U.S.

The Consort program is being augmented by the Joust program at the UAH Center. Its first commercial flight is scheduled for later this month. The Joust launch will almost double the time in low gravity than was provided on the Consort.

Many of the CCDS commercial activities will come to a focus during the era of Space Station Freedom. It appears that the initial man-tended phase of Space Station will emphasize microgravity research. This would seem to indicate a belief in the potential economic importance of these activities. Some of the equipment which will fly on the Station may largely be models that have evolved through development operations on less expensive space carriers and projects such as Consort and Joust. This evolutionary approach helps ensure proven equipment with good prospects of success at relatively low hardware costs.

An established commercial philosophy would facilitate the efficient flow of commercial programs into the Space Station and I support that approach.

I am very proud that Alabama through its three Centers and particularly the Center at UAH is providing leadership for this important NASA sponsored program and I wholeheartedly support the increased funding request for this fiscal year.

Thank you Mr. Chairman.

Mr. HALL. The Chair recognizes its ranking member, Mr. Sensenbrenner.

LICENSING OF NASA LAUNCHES

Mr. SENSENBRENNER. Thank you very much, Mr. Chairman.

I would like to explore with you, Mr. Rose, the relationship between your office and the DOT's Office of Commercial Space Transportation. As you know, the Commercial Space Launch Act gave DOT licensing authority but that NASA could take things out of the commercial space launch by basically declaring an exemption. And there were five flights that were exempted—the Mars Observer, the goals I, J, and K, and the Soho, where NASA, in effect, asserted control over these flights.

Let me ask you, isn't there a conflict in the law in that NASA can assert its control and thus take it away from the commercial sector, and NASA also determines who gets exempted and who doesn't. Doesn't that kind of put you in the position of being prosecutor and judge?

Mr. ROSE. Mr. Sensenbrenner, that is an area that my office, the Commercial Space Office, has not dealt with. The launch vehicles in that case were handled through Code M, our Office of Space Flight.

On the legal, let me just say that all of the launches that the Commercial Programs Office sponsors, the sounding rocket launches, which Mr. Cramer just mentioned, and the new sounding rocket we're going to fly the end of this month, and the COMET will all be licensed by DOT. We comply totally and we work very closely with DOT. In fact, they have been a major asset in helping us determine what we're going to have to do to get license for the reentry part of COMET, which is going to be a land landing.

And so the Agency—I would feel that I couldn't answer your question because I haven't been a party and that wasn't part of my responsibility in dealing with that particular issue. However, we can certainly take it and provide an answer for the record.

Mr. SENSENBRENNER. I would hope that you would do that.

[The information follows:]

Material requested for the record on page 25, line 570 by Cong. Sensenbrenner during the March 5, 1991, hearing.

The question combines two independent issues. The first relates to NASA's implementation of the requirement of Title II of the FY 1991 NASA Authorization Act to procure expendable launch vehicle (ELV) launch services in a commercially reasonable manner. The second is whether a license under the Commercial Space Launch Act (CSLA) is needed for launch of certain NASA missions.

NASA actively and enthusiastically supports the requirement to procure launch services in a commercially reasonable manner. It also is NASA policy and practice to utilize commercial launch services for its ELV launches whenever such services are available. The procurement methods used to purchase these launch services were developed in a continuing dialogue with the commercial launch industry, including three industry-wide symposia at which all aspects of NASA's new procurement approaches were discussed. We feel we have been very successful and, except for mission-unique details, purchase launch services utilizing launch vehicles produced on commercial production lines, to commercial specifications, compliance with which is verified using the contractor's own quality systems. In short, a close examination of NASA's current procurement practice will show it closely follows the commercial practices on which it is modeled. Based on its industry symposia and the number of launch services purchased, NASA is the government leader in its reliance on commercial launches in performance of its programs and is in full compliance with the laws and policies relating to use of commercial launch services.

A separate issue is whether a given launch requires a Department of Transportation (DOT) license under the CSLA. This issue is determined by reference to the CSLA, its history, and its purposes. The CSLA expressly exempts government launch activity from coverage whether or not that launch activity utilizes commercial launch services. The executive branch agencies most involved in the issue (NASA, DOD, DOT and Justice) now agree that this exemption includes launches of government payloads where the program agency is substantially involved in the launch. This conclusion concerning the need for a launch license does not "take [the launch] away from the commercial sector." All it means is that, as was the case in the General Dynamics launch of the Chemical Release and Radiation Effects Satellite (CRRES) mission, NASA's contractually provided involvement results in a commercial launch service being exempt from the CSLA licensing requirement. The reason for this is that the purposes of the CSLA (e.g., protection of public health and safety and establishment of a single point of contact within the Government) are being served by the provisions in the NASA contract. The five missions mentioned (Mars Observer, SOHO, GOES I, J, and K) also are commercial launches which fall outside the scope of the CSLA licensing authority. Since the licensing requirement of the CSLA and the Government's use of commercial launch services are independent issues, the possible conflict referred to does not exist.

Mr. SENSENBRENNER. And let me say that I think that NASA sends a very bad message to the commercial space launch industry every time it takes one of these launches away from the contractors by stating that there will be NASA involvement and NASA control over it. I would hope that there would be some kind of a more balanced approach to the problem. If the contractors decide to go full speed ahead and all of a sudden find that NASA puts a brick wall in front of them, certainly that's not the type of relationship that NASA should have with the private sector.

Mr. ROSE. Being representing the private sector, I don't necessarily disagree with you in anything. It is just that I am not in the middle of that and have not been, and, therefore, I don't know the intimate details.

Mr. SENSENBRENNER. Well, let me say that since you're supposed to be representing an expansion of this, perhaps there should be an advocate within the council of NASA to expand the role of the private sector, because I am hearing some rather disquieting views from the private sector of the economy with NASA in the position of being the prosecutor and the judge.

Mr. ROSE. We have established recently a new committee, if you want to call it that, reporting directly to the Deputy Administrator; this includes myself, Bill Lenoir represents Space Flight, Len Fisk represents the Office of Space Sciences; all of the AAs to deal with problems across the Agency to do with commercial. This is the type of forum that hopefully we should have look at this particular issue from your standpoint of view and understand why we do it, does it make sense, and what are we going to do in the future.

But there are many things pertaining to commercial space that go well beyond the scope of what Office of Commercial Programs can legitimately control. We can always advocate, but without having a forum to advocate in, it is sometimes difficult. We now have that forum and I can advocate that.

Mr. SENSENBRENNER. Well, that's good.

Thank you very much, Mr. Chairman.

Mr. HALL. Thank you, Mr. Sensenbrenner.

The Chair recognizes Mr. Lewis.

Mr. LEWIS. I would defer at this time, Mr. Chairman.

Mr. HALL. The Chair recognizes Mr. Cramer.

Mr. CRAMER. Nothing further, Mr. Chairman.

Mr. HALL. Well, we'll get down to the real question and answer series here then.

Where is SII? I know SII is Space Industries, Incorporated in Houston. Where is SII located in Texas?

Mr. ROSE. It is located in the Clear Lake area outside of Houston, Texas, about 20 miles down the road.

Mr. HALL. On the Brian side?

Mr. ROSE. It is right off of Highway 3. You know Highway 3 there through Ellington Air Force Base.

COMET

Mr. HALL. You, in speaking about COMET, said the first system commercially developed, and then you went on and said some other

things about it and I lost you there. What did you ever say about it being cost-effective?

Mr. ROSE. I think it is going to be extremely cost-effective because we've allowed the CCDS's to put a team together to carry out this—I want, you know, to kind of talk to what Mr. Smith—I think there's been some confusion.

Mr. HALL. Well, Mr. Smith will be back and he'll probably will ask the question.

Mr. ROSE. Good, good. We need to clarify that because the COMET is strictly a commercial enterprise. The CCDS's have payloads they need to fly. We allowed the CCDS's, on their own, to establish a performance specification; we're not buying an engineered spec, NASA-type procured system, we are buying a developed system. This is not a development program, it is a program to buy service. And, in so doing, the CCDS's, six of them combined their talents to put together a very, very good commercial form of a specification, went on the street with that; in fact, they did everything in a very professional way; held competitions, they had a bidders briefing, 61 companies showed up at the bidders briefing in Tullahoma, Tennessee, and Tullahoma is not easy to get to. It represented the interest out there of people wanting to provide a commercial service.

This is the most commercial thing I think this Agency has let happen. These people put out a performance spec, they had 14 different companies bid on some 24 different packages of work. Of that number, three were finally selected in a very competitive way. I can tell you SSI, Space Services, Incorporated, which won the launch vehicle, their launch vehicle development costs were paid for by their own investments over the last ten years. And this is their first opportunity to compete and win on a competitive basis this support.

So what we have done is to find a formula that allows—and this whole system happened in a year's time, it was all put together, and it is not only a launch vehicle, it has got a reentry vehicle, it has got an on-orbit bus, it has got a payload integration package, it has got a systems engineering package, as well as a space operations package that had to be competed and selected and what have you, and it was all done in less than a year. That's what the American entrepreneurial industries are looking for; things that can be done quickly. By the time they submitted their bids, an answer was given in four months. That's very good.

And right now we don't have this capability in this country to bring things home in an unmanned way, and the Free World doesn't have this capability. The Chinese do. The Long March, they have rocketed things into space and then brought them back. But we don't have that capability and we need it. It expands the capability of this country and it gives three private firms in the United States an opportunity to then go sell that service to everybody else in the world, and we're at least two years ahead of Europe in getting this type of capability. So it was important that we do this.

Mr. CRAMER. Who are the other two private companies? You mentioned one.

Mr. ROSE. SSI won the launch vehicle; SII won the payload integration, they won the reentry vehicle, and the reentry vehicle is

based on Mercury-Gemini technology; and Westinghouse won the on-orbit system.

Mr. CRAMER. Thank you.

Mr. HALL. It's true, isn't it, that part of COMET is being procured under a cost-plus contract?

Mr. ROSE. The launch vehicle, which is the biggest part, is a fixed price contract.

Mr. HALL. So, logically, if there is any cost overruns, NASA is going to foot the bill.

Mr. ROSE. No, we're only buying a service; they will have to fund anything that they—we've set a fee of what we're willing to pay. If they overrun, that's——

Mr. HALL. That's theirs.

Mr. ROSE. That's theirs. And, see, we're only buying a service. It is their development costs. You know, if they go out and sell ten more of these launch systems to other firms, maybe they're spreading their development costs over ten vehicles instead of the three that we are contracting to buy.

Mr. HALL. You describe COMET as a commercial purchase.

Mr. ROSE. It is as truly a commercial purchase as anything the Government can do.

Mr. HALL. And you're not—so you won't be hit with the overruns?

Mr. ROSE. No, sir. I think one thing it is also important to point out when you do talk about buying a service. Doing anything, if you put the incentives in the right place, people will perform. Since we're not going to cover any overruns, we're simply buying a service, they are highly motivated to make it work and to make it work quickly so that they can begin to market this capability elsewhere. We are strictly helping to set up a commercial enterprise as well as to solve our own immediate needs of having 23 payloads we want to fly in this mode.

Mr. HALL. You say that COMET would put U.S. industries in a position to compete internationally in the very near future.

Mr. ROSE. My understanding, the three people who won the elements are planning to market internationally this summer the COMET system. They would like to fly within a matter of—we're going to have the first flight in 18 months. That's really kind of unprecedented. You don't do a lot of developing in 18 months.

Mr. HALL. Other than the researchers for CCDS, do you have other commercial customers for COMET?

Mr. ROSE. It is their job to market their own infrastructure and capability, which they will then go to Europe, I'm sure, and talk to people like Intospace, they will probably talk to Nova Spas in Paris, and I'm sure they'll go to Japan. There are going to be a lot of people out there who are ultimately going to want to have this type of capability. What we were told was that the people in Europe and Asia who are thinking about this capability are still about a couple of years off, so we might have about a year to year-and-a-half grace on being in front of them.

Mr. HALL. I want to get back with on you CCDS, which you described as the heart of the program in a little bit. And you know some other questions that I'm going to want to ask to establish a record for but I've used all the time that I'm allowed.

I recognize Mr. Smith. He did come back.

Mr. SMITH. Thank you, Mr. Chairman. I'm glad to know that my position upon arrival was preserved. I appreciate that.

Mr. Rose, a couple of questions in regard to COMET. The first question is, How do you propose to charge customers for the flights aboard COMET?

Mr. ROSE. We don't. The CCDS's have a need of a month's time in space and then the reentry capability to bring their hardware home. We cannot get that with the Shuttle, we need to at least grow certain protein crystals at the University of Alabama, Birmingham——

Mr. SMITH. Did you mean to say a while ago that you were not going to charge customers at all?

Mr. ROSE. I am buying a service. I'm flying a payload. We are a customer. I need a commercial—somebody is very confused. We are not building or developing——

Mr. SMITH. I understand that, but there are obviously a lot of costs involved, development costs and so on, and all of those are going to be subsidized by the Government.

Mr. ROSE. No. No, no. I'm buying a service. I'm not engineering a development program. I'm simply saying the CCDS's said we need a launch vehicle that will put 1,800 pounds up in orbit and we want to be able to bring 500 pounds back and land it on the land.

Mr. SMITH. Right. I know you're buying a service. Who is paying for the service?

Mr. ROSE. I am buying, through the grant program, the CCDS's are using our grant money to provide this transportation, just like we're using the——

Mr. SMITH. The grant money is Federal money.

Mr. ROSE. The grant money just like we're leasing the SPACE HAB. It is the same thing. The Government is furnishing, through the CCDS, the capability to go into space.

Mr. SMITH. And so the individuals who would make use of COMET flights are not going to pay anything for that in any way, shape, or form, or what?

Mr. ROSE. They are. The CCDS's are paying for that service. It happens to be funded from money being funded through the CCDS program by my office. It is the same as when I lease a contract for the SPACEHAB, to lease space on a SPACEHAB. We are funding SPACEHAB with Government money to provide 81 flight test opportunities for the CCD's. We're not interfering with any—in fact, we're the only program that is giving an opportunity to the entrepreneurial transportation industry to bid in a commercial way to provide a service. And I don't understand the confusion.

Mr. SMITH. Right. Mr. Chairman, I'll follow-up perhaps more later on with some questions submitted for the record because I don't want to prolong this, except that reading from my questions—and, unfortunately, I didn't hear the answer that I wanted to—is that it seems to me that the direction COMET is going it is going to invariably squeeze out the private sector from competing with COMET in any shape, form, or manner. And I think that that's not——

Mr. ROSE. No, it's not at all. Deke Slayton, who won the launch vehicle under competition, there were three other launch vehicles

competed to provide a service to the CCDS, he has put up I don't know how many millions of dollars over the last ten years out of Houston, Texas, to develop a truly commercial launch system he calls Conestoga. Conestoga competed with an Orbital Sciences system and there was a third launch vehicle submitted a bid competitively to provide a service. We're simply buying a service. We are not trying to develop a new launch system in competition with anybody. We held a competition with all potential bidders who wanted to supply a launch service. We tried to help the industry, not to crowd anybody out.

Mr. SMITH. OK. I'm going to take you at your word on that last phrase that you intend to help the industry.

Thank you, Mr. Chairman.

Mr. HALL. The Chair recognizes Mr. Lewis.

PRESIDENT'S COMMERCIAL SPACE POLICY

Mr. LEWIS. Thank you, Mr. Chairman.

Mr. Rose, with the President's Commercial Space Policy, as an advocate of the space vistas, are you comfortable with the DOD and NASA's commitments and the other agencies toward a Commercial Space Policy?

Mr. ROSE. Are you referring to the new Space Policy that the National Space Council——

Mr. LEWIS. This would be October of 1991. Well, let's put it this way, are you satisfied with the President's current Commercial Space Policy?

Mr. ROSE. The one that has just come out of the National Space Council, which we have just reviewed, when you interpret it and look at it in a positive light, what they are advocating will support what we're doing currently and we think will give us the necessary support for enabling the things we feel necessary should be done in the future. It could always be stronger, but we think that the interpretation we've put on it, we're satisfied that we've got some good language and we've got something that supports the type of JE—Joint Endeavor—programs we envision in Phase II, and, ultimately, will give us the capability to do some of the things we might have to do in support of industry in Phase III.

ELECTROPHORESIS PROGRAM

Mr. LEWIS. Okay. I would like to just discuss with you a moment a few of the programs that you're looking at. For example, the electrophoresis program that we're looking now that this process may be used by researchers at CCDS. Do you have plans to fly this equipment again?

Mr. ROSE. The technology of the electrophoresis program has been transferred to the CCDS at Pennsylvania State University. They have quality researchers in thermodynamics and the fluid mechanics and in the areas that are needed in order to continue to advance this technology. The past developers of the technology from McDonnell Douglas Corporation are under contract to support the Penn State effort so that there is an orderly transfer. Penn State, when they get their industry partners together, are contemplating using that technology in the 1993 time frame.

Mr. LEWIS. Well, it was my understanding that McDonnell Douglas and Johnson and Johnson had written off these programs because they found less expensive ways and better ways to do it on the ground rather than flying the projects.

Mr. ROSE. Well, when the McDonnell Douglas program was phased out, it was during the time frame that Challenger was down. There was no way to get the technology into space, and with 150 people sitting at the plant waiting to go do something, it was the type of program that couldn't be sustained in that time frame.

The technology of electrophoresis was proved to be quite superior in space. The production of one product through that technology was what McDonnell and Johnson and Johnson were attempting to do. The technology could support an untold number of other materials that the industries might very well be interested in. It is a process that is multipurpose in the sense that you can process any number of hormones or enzymes through that machine for both research purposes as well as maybe production purposes. So it is a technology that should not be abandoned, and Penn State sees the virtue of the technology of separation. That doesn't mean that electroporesis, because the McDonnell effort which wanted to produce erythropoietin and found itself with a three-year hiatus could compete with genetically derived materials that could be produced but it would still be expensive.

Space and electrophoresis might very well reduce that cost ultimately. Most of these exotic drugs, I was just listening on the news the other night to this research on the quality of tissue plasminogen activator that dissolve blood clots, it's still, and it is genetically derived, very expensive. Genetically derived material isn't expensive to produce once you learn how. It is the purification of it that's expensive.

Mr. LEWIS. I yield to the Chairman.

Mr. HALL. I join the Gentleman from Florida's interest in this and I think it might benefit us some and save some time from my questions at a later time if you would just kind of go through the steps to commercial operations and give the committee the benefit of that that effects it, and the effect that the loss of the Challenger had on it, which was a gap in the productivity and the long-range planning, as I understand it. Would you touch those bases for us.

Mr. ROSE. The McDonnell——

Mr. HALL. I think your answer will tell us whether or not we agree with McDonnell and Johnson and Johnson for taking the position that maybe there was a better way to do it than the interrupted way they were doing it, and what that subjected them to market-wise and time-wise.

Mr. ROSE. The program was put together because of the promise that the technology of electrophoresis could provide a very good separator of very delicate natural biological materials, that you would derive these materials through cell culturing of natural cells. The advantage that space tended to offer was the fact that you could take this technology which was good in the laboratory on the ground, and because the gravity limited the amount of material you could process through it, by going into space, it made it a reduction device that could separate at some 700–800 times more material per hour. So the program was scoped that McDonnell

would develop the technology of electrophoresis, ultimately through the development of a product that Johnson and Johnson had selected as being the right one to go for, and move this through a program that consisted of four flight tests early on in the Shuttle to determine the suitability of the technology to the environment. Could you really get the improvements that you had analytically assumed that you could. And this was to be done over the course of a two-year time period and flight time period, and then move to a program that would be a development program if the technology was suitable, which the development program would produce enough material to do the clinical testing and then you confirm the scale up with a big production plan in the payload bay, and then you would start commercial operations for two years going up and down the Shuttle. It was deemed that that would produce enough material that you could get a commercial enterprise going. And time was very important. Every year you delay getting the cash-flow going, the return on investment gets smaller and smaller on your internal revenue.

Mr. HALL. But you were just grabbing time from the Shuttle as you could get it?

Mr. ROSE. Using the Shuttle as a basis to explore the technology in space. We would ultimately move to a free-flying platform—we were looking at both the Leasecraft from Fairchild and also the ISF from Space Industries, Incorporated, who were pursing that as a commercial venture—with visits by the Shuttle on a three times per year basis was our ultimate operational goal, which would have occurred in about the 1989–1990 time frame if we had been on schedule.

We flew the first four flights without a hitch. We flew them on STS number 4, then six, seven, and eight in a row. We determined the technology to be superior in space. It did what we thought it would do. We verified that. We then moved into a development program in which we converted the machine to a production machine that was to run continuously from the time it reached orbit until it returned. We flew our own astronaut with those three flights, it was Charlie Walker, and he was there to help work out the bugs and make sure the system would work.

In the meantime, we had a production plant coming that would go in the payload bay, a 5,000 pound device, that was into qualification testing and schedule to fly in July of 1986 on its first of two flights of the joint endeavor. That's when Challenger went down. At the time, we had switched from a natural source of providing the material—our problem was not with the electrophoresis, it was getting the genetic material base that was necessary to produce the hormone we wanted to process and Johnson and Johnson wanted to put into clinical testing and to market.

Once we finally got a genetic system working, we were producing extremely high pure erythropoietin, but the Challenger went down. We had no where to go to produce it with that process, and we had no knowledge of how much time would be taken. So the company had to make a decision. Johnson and Johnson went with another company that was making it through a ground-based process using genetic engineering that was producing it in a quantity that with even crude methods of separation you could do it and scale it to a

point that the people out there in the market could afford, not that it was cheap, but it put it in a range that was affordable. Genetic engineering, not only do they need methods to produce it, but to produce it in the quantities that the natural cell didn't produce it. So the amount of purity was reduced. That does not mean that electrophoresis will not compete, in fact, it might compete very well once we establish a base in space that we know what space is ultimately going to cost us. I think that is why as a process it is a good process, it was proven to be that in the early space flights. The problem was it was then focused on producing one product, and that product, incidentally, was $1 billion a year product, and that is what it is anticipated to be now. It is a major product and it is going to have major impact over the health problems in this country and in the world. It is being marketed internationally now.

Mr. HALL. Thank you very much for that step-by-step. The one thing you missed was the first flight I believe everything got contaminated by bacteria, so you had to do it again.

Mr. ROSE. Well, we had planned two flights, that's right.

Mr. HALL. That's all right, you don't have to——

Mr. ROSE. But Charlie Walker, we brought it home, and the reason it was contaminated was there was a day's delay on the pad after we had serviced the machine and the filters, which already probably had some bacterial overgrowth in them, it spread. The next flight we put in filters late and we turned the machine on on the pad so that it operated like a refrigerator, and from that point on we never had any trouble with that aspect of it.

Mr. LEWIS. Yes, that's what my concern is, when we have Johnson and Johnson and McDonnell Douglas write it off because of the hiatus because of the Challenger. So much of an effort went into this and the procedures seemed to be pretty well down the pike in order to go with this thing, and it looked like it was going to fade away, and now we're back again. I am just concerned that it goes to a CCDS and it is just going to be another program that we may consider looking at on a time and space available basis.

Mr. ROSE. You mean that it would have more priority if it was an industry push?

Mr. LEWIS. I think it might be, yes.

Mr. ROSE. Well, we don't do anything in the CCDS unless there is an industry to push it. Penn State, there—we don't fly anything from a CCDS standpoint of view that does not have strong industry support and interest. That's the difference in the CCDS and CODE-S type programs. We only fly things that are mature and have a strong industry support and a potential application associated therewith. So Penn State is off trying to get that.

What I indicated to Chairman Hall earlier, what we're trying to do through the CCDS program is create a lot of the types of things McDonnell and Johnson and Johnson were trying to do—getting industries who weren't willing to take that ten year step that we were willing to look at and begin to get them involved in the front end through CCDS's with the hope that they would then move aggressively into the second phase of the program, which is where the Charlie Walker phase started. The first four flights were really technology flights, then we moved into a development phase—and when I talk about the three phases of the programs we're setting

up through the CCDS's, there is a Phase I, which is technology, we're looking to a development phase where industries take those technologies and move them into development, and then, hopefully, commercial enterprise.

Mr. LEWIS. One final question, Mr. Chairman.

PHARMACEUTICAL RESEARCH IN SPACE

Five or ten years ago a lot of people discussed and talked about manufacturing drugs and electronic materials in space because you get the perfect homogeneous mixture, weightlessness, and so forth. Has anyone actually developed anything they're making a profitable business out of out of this kind of operation. Pharmaceutical companies do not have very much money to go into research of this type. So what would it take, in your judgment, Mr. Rose, in order to accelerate R&D in this area?

Mr. ROSE. You're absolutely correct. No one has made anything off of producing anything in space because the technology basis hasn't really been established. There has been very little done in space if you really look at what has flown and what hasn't flown, and those things where industry has been involved have been—you can count them on your hand. 3M has flown, McDonnell Douglas and Johnson and Johnson flew. They are the only two that I know of who have really done something in a product oriented vein. 3M through the work they have done has concluded there is no question they have produced a material that is unique to space and have patented it. They haven't found an application necessarily for it, a specific application within their own company, but it is a different material and they have verified that through four flight tests.

The CCDS program is what we're trying to use as the focus of getting those industries and the academic community working together in specific areas that industries are interested in seeing, with a hope that that's going to generate this surge of industry interest to move it into real developments that can move to real applications. This is not going to be a simple or fast process. You have got to lay down the technology. Can we do anything—access to space, flying. That's the only thing that's going to establish that technology base.

Time is critical to industry. The biggest difference between the way industry does things and the way the Government does things, in industry, time is all significant. And if we don't fly them in a timely manner, if we stretch things out, they are going to lose interest and go away, industry will, and that will leave us with some CCDS's and no industry support. So it is very critical to us to carry out as aggressive a flight program as we possibly can to lay a technology base of understanding and that industry can then take that piece of information, he says this is how it works in space, this is how it works on the ground, this is the technology I'm interested in, can I define an application now that I am willing to take forward in a development mode to get to real products.

I think you're probably talking—you'll have some isolated instances where things happen faster, but I think you're talking the end of this decade before you really see the products coming out of

it. You are going to hopefully see some industries getting really interested in about the 1993–1994 time frame. But we've got to get the technology under our belt.

Mr. LEWIS. Thank you, Mr. Rose. Thank you, Mr. Chairman.

ELECTROPHORESIS PROGRAM

Mr. HALL. It doesn't seem to me that electrophoresis has really had a fair shot at success.

Mr. ROSE. No, it hasn't. We moved as quickly from a research device into a real application, and Penn State is going to broaden its scope a bit and make it look on a much broader basis of what it can do.

Mr. HALL. You had to grab a flight here and a flight there, and then you were interrupted. I guess one of the reasons Johnson and Johnson went to the ground process was just another by-product or another indication of the severity of the loss that was spawned by the Challenger tragedy. It is just another of the many setbacks that we took.

Mr. ROSE. Industries are interested in basically making money, developing products and making money. If space can be proven to be a place where they can do that, they will come. The problem is space is very expensive to get there to even do research. That's where the Government's role and responsibilities go. That's why we have to fund CCDS's to carry out research, we have to provide COMET's, and we have to provide sounding rockets, and we have to provide SPACEHAB support to get these people to do the testing that is necessary to determine where we go from there. And this is the role of the Government, this is the important role of the Government, and if we don't do it, there is no question in Europe, it is all Government; everything that's done is supported through Government financing, there is no private industry trying to do things on a commercial basis in Europe yet.

Mr. HALL. You had to grab a flight as you could and the Charlie Walkers as they came. You really were though the shepherd weren't you? For electrophoresis, didn't you guide that through and wasn't that your——

Mr. ROSE. Yes, I was the founder of the program and I watched it go where we are.

Mr. HALL. Okay. Was it based on your background at McDonnell that they were selected? Or how did you come together there?

Mr. ROSE. With Johnson and Johnson?

Mr. HALL. And McDonnell Douglas. You weren't with Johnson and Johnson ever?

Mr. ROSE. No, I never worked with Johnson and Johnson. What we did, again, looking at it from a business standpoint of view, we hired Price Waterhouse, not their accounting but their business management organization, and they put a study together for us of the pharmaceutical industries. They did a very good study and they ranked them based on a number of criteria. One of them is how much are these companies investing in R&D. And they came up with a list of the top ten that they thought we should visit. We actually ended up visiting about 12 or 15. Johnson and Johnson was the one company that came first and said, hey, we would like to

join you actively. A number of these companies said, hey, we're interested in what you're doing; keep us informed.

Mr. HALL. But not too many of them came with the cash, did they?

Mr. ROSE. Johnson and Johnson was the only one that came with the cash. We worked out a very detailed plan of how we would work together, how we would split the revenues, what the responsibility was. It was totally a business arrangement. They did a very detailed market research on several products. The one we chose was one that after they looked at it their eyes watered; I mean, they said this is going to be a major product. Then we set off to go do this. But we had two jobs to do at McDonnell. We not only had to develop a technology of processing the electrophoresis, but we had to learn how to develop a cell system to produce the hormone on the ground so that we could take all this soup and go to space and purify it. So we had a double duty of things to develop. You learn a lot.

Mr. HALL. Well, everyone I think was excited. Of course, as we looked at the brochure that was put out at that time and could just see electrophoresis operations in space spawning a cure for the dreaded disease, and, particularly, the first thing that comes to everyone's mind is cancer, that we've not been able to find here on earth and in gravity. And I want to ask you to answer this but back at that time somewhere I read that those that manned the 1982 process verification and then maybe the fourth mission in 1983—you had three in 1983?

Mr. ROSE. That's correct.

Mr. HALL. The fourth one, that there was great anxiety among the crew that from the crystals or the pharmaceuticals or whatever you developed in the weightless environment there might be the key to about 68 percent of the types of diabetes, which would be, my God, what an accomplishment. That would make the whole program worthwhile in a snap of your fingers, even if that's 10 percent true.

Mr. ROSE. Yes, we were flying at the time, one of the flights was the—we had two major, very significant researchers at the Washington University School of Medicine in St. Louis, Doctors Lacey and Sharp, who were doing research on trying to isolate the Beta cell, which is the cell in the pancreas that produces insulin. If you could isolate that former pseudo islet, let them reform again, isolate it from the alphas, the gammas, and the rest of the material, you could implant or transplant that material in a diabetic. It would begin to function like a pseudo pancreas producing the insulin naturally to the body's signals and you wouldn't reject—that was the key. Juvenile diabetics obviously contract it very young and it is very damaging and very life-shortening. You don't want to put them on immune-suppressing drugs because they have got to live the rest of their lives with this, so you've got to find a way to do these transplants and not have the body reject. And Doctor Lacey, through animal testing, thought he had found a way to handle the cells so they wouldn't reject. I might say this research does continue, they are making some progress. There are three or four different activities still going on. They are into transplants on diabetics at the present moment in St. Louis at Washington Uni-

versity. And I am not certain we aren't too many years away from having something like that that will work.

Mr. HALL. Was the driving an impelling part of that optimism based on the fact they could produce and do what they were doing in quantity and there, again, let me reconstruct it. You were grabbing every shot you could get on any of the launches and doing it and doing your procedures as they orbited and did other things, they had other programs, and you were interrupted by the Challenger. Did Johnson and Johnson drop its interest because of a method to produce material on the ground looked better or did they drop it because of the Challenger accident?

Mr. ROSE. They thought it would be quicker.

Mr. HALL. On the ground would be quicker?

Mr. ROSE. Once the genetic people had performed a breakthrough on how to take a gene and put it into a cell line and have that cell line produce what the DNA information, which is like software, told it to produce, not only did they find that you could do that genetically, but the cell itself is much more potent than the natural cell. So the amount of separation you would have to do went down and made it practical now to do it on the ground. Not that it was going to be cheap, but J and J said cheapness isn't the key; the key is to get to the marketplace first. Don't be the second to market it. Not better but quicker.

Mr. HALL. And so then the Challenger accident, just for the record, the Challenger accident intervention did cause Johnson and Johnson to go to a source that could produce material on the ground.

Mr. ROSE. Yes.

Mr. HALL. Did McDonnell Douglas drop out because Johnson and Johnson dropped out?

Mr. ROSE. No, McDonnell went ahead——

Mr. HALL. Or because of the accident?

Mr. ROSE. And tried for some time—well, yes. We looked for other uses and other people who would be interested. Again, one of the problems was even though we had gotten into genetic materials, the time of it was still—the people that we were contacting and almost had arrangements with eventually decided not to pursue it because, well, one of them didn't want to pursue it because of the often drug act that Congress was threatening to change that would not make it possible for them to take a proprietary position in one application of this material. So they were worried the Congress would change something and then they wouldn't have a proprietary position, so they backed away.

Mr. HALL. I piggy-backed on Congressman Lewis about as long as I can without trying to charge it against myself. So I think that I've extended.

Mr. Bacchus, we recognize you at this time.

Mr. BACCHUS. Thank you.

Mr. HALL. I want to come back to that when I can find somebody that will give me some time.

Mr. ROSE. All right.

Recompetition of CCDS Awards

Mr. Bacchus. Mr. Chairman, you can have all the time you want.

Mr. Rose, I have several questions. Getting back to the CCDS program. I agree with what you said in your testimony that it's critical to our commercial space efforts, and I am happy to see that the industrial contributions are increasing overall. But in looking at the 16 different sites, I see that there are several of them where we have been lagging behind in terms of dollars contributed and in terms of private matching funds. Have you considered having a re-competition that would enable some other parts of the country, some other potential centers to get involved, some places that might have greater potential for attracting some of those private matching funds. I won't suggest any, but some of them might be in Florida.

Mr. Rose. Mr. Bacchus, we believe that the proper way to manage the CCDS program is to—We do have a criteria on what we've asked them to accomplish, and we do evaluate them annually. If they aren't performing the way we think they should perform, rather than arbitrarily at that point cutting them off, we give them a year to adjust what we think are the weaknesses. And let me just say, we have had several that we've had to send letters to and in all cases they have immediately turned their programs around, gone out and gotten the type of industry support they should have gotten. My management philosophy of what I would like to do is, if they don't straighten up in a year's time, we will phase them out and in so doing we would probably want to have another competition and add.

Mr. Bacchus. Do you have any that are on this probation now?

Mr. Rose. Yes, I have a couple. Also, in looking at how much they are able to attract to some degree depends on what type of technology they are working in. Some things are more interesting to companies and they are closer to having something that could happen, as opposed to some of the others. So we do take some of those things into consideration. But it is easy to say let's add more and more centers, but it gets harder to manage also and to keep them in driving—We're here to kind of steer the boat not to try to tell them what to do.

Mr. Bacchus. I wasn't suggesting that we add more. I was suggesting that you might want to consider ending the probation for some if they don't do right; get some other——

Mr. Rose. We would intend to do that. That is absolutely part of our management system.

Funding for Spaceports

Mr. Bacchus. Good. A second question. To give you some background, before I was elected I was very actively involved in the commercial space effort in Florida. I was among those who helped create the Spaceport Florida Authority, I was on the board of the Space Business Roundtable there. You are going to find me to be a champion of the things that you're working towards. The Federal Government historically has provided a significant financial support to help in the development of seaports and airports. It seems

to me that a spaceport is just another version of that. Has there been serious consideration in the Administration of providing active Federal involvement for the development of the infrastructure for launchpads for spaceports, especially in those States that have taken the initiative themselves and that would be willing to provide some matching funds?

Mr. ROSE. Let me say what we're doing. We had a management council with the CCDS's in Nashville, Tennessee, about two weeks ago and one of the things we want to do and plan to do is to contact all the States who have shown, like Florida, Virginia, Hawaii, we have a COMET that we haven't made a decision yet exactly where it is going to launch from. We have sounding rocket programs that right now because of range problems, we have a lot of trouble with the range at the Cape, looking for more of commercial places to do things. And we want to engage in discussions with the States. We have several things now that we're sponsoring through the CCDS program that require launches and require launch capabilities and payload handling. We are going to have a bunch of payloads that are going to be flying on these systems. And so we are going to go and enter into discussions because here we might be able to provide the launch vehicles and the things that a truly commercial range might very well find attractive to help get it started.

Mr. BACCHUS. I want to encourage you to do that. Of all the many good and important things that you're doing, I can't think of any that would be of more help than providing this infrastructure for launch facilities and otherwise.

Mr. ROSE. Well, we agree that you've got to have the proper infrastructure. You have got to have that. The more we see of working on ranges—Government ranges, the commercial world does not have priority. We believe that we have to have the infrastructure set up with companies who know how to build things in a commercial way, like the sounding rockets, like the COMET program, like others that we're seeing developed. And I believe as we get more of these things in place, it is going to be enough of an activity to allow a real spaceport to begin to operate.

SBIR PROGRAM

Mr. BACCHUS. Wonderful. One final question. You dwell at length, and I think rightly so, on the SBIR program. You have a 1.5 percent set aside of your research money for small businesses. Would economic growth be enhanced if we increased that percentage of set aside?

Mr. ROSE. It is actually a 1.25 percent. I think it has been looked at—Frank, wasn't that looked at by—Some people have looked at it going even further, I believe, isn't that right, John?

[A discussion with assistant off microphone.]

Mr. HALL. And that statement is made by John Glaab, for the record's sake.

Mr. BACCHUS. I'd appreciate any information you could give me on that program and how it works and the various proposals.

Thank you, Mr. Rose. Thank you, Mr. Chairman.

Mr. HALL. John, I think in order to get it on the record, if you would just come repeat your statement into the microphone where

we can have it on the record. Appreciate it. We don't have to swear you in or run you through the belt line or anything. [Laughter.]

Mr. JOHN GLAAB. Thank you, gentlemen. I am John Glaab, the SBIR program manager at NASA Headquarters. To repeat my comments, there have been several meetings of the SBIR managers throughout all the agencies—DOD, and all of the other member agencies. We have all looked at this and have discussed the possibility of an increase. We knew that people were talking about a 3 percent increase. We've all looked at our programs, examined old proposals to see how many proposals we're turning away that would qualify for additional funding if we had it. We've all felt that if you went to 3 percent, we might be actually funding things that were marginal. If we went to 2 percent, we felt that we could handle that comfortably, but to give you any finer information on that would take a lot of analysis which we just have not as yet done.

Mr. BACCHUS. Thank you, again.

Mr. HALL. And I think Mr. Penaranda, you made a statement. Do you want to make it into the record.

Mr. PENARANDA. As I said before, we did begin the SBIR program by ramping up from a lower percent to 1.25 and that that information that John Glaab gave you OSB looked at.

TECHNOLOGY UTILIZATION

Mr. HALL. And do you want to make any type statement as to what is going to happen if you don't get the full increase that you want for the technology utilization; either of you, Mr. Rose?

Mr. ROSE. Well, the technology utilization I think, with the rescoping of what we're trying to do, will obviously be set back. It is time that we in this country spend a little more attention on technology transfer because I think it is fundamental. A Government creates an awful lot of technology and that can be a major player in the competitiveness of this country. And so when we do cut TU back, we are in essence cutting out some of the functions and some of the work that we're doing in the transfer process. So I would encourage the committee that I think it is significant that we do as much as we can in getting a good transfer system for the 1990s and on out into the next century established.

Mr. HALL. Mr. Bacchus, you have other questions?

Mr. BACCHUS. Not at this time, Mr. Chairman.

Mr. HALL. All right, thank you. Mr. Bacchus is a key member of this subcommittee because he represents the Kennedy area and of his very genuine support for it. So we appreciate your attending. Let me tell you, you've had a very good attendance here today. I think 11 or 12 members have been here at one time or another.

Mr. Rohrabacher, we would recognize you for either opening statement, in-between statement, or closing statement. [Laughter.]

Mr. ROHRABACHER. I'm sorry I was late.

Mr. HALL. That's all right. We know the other committees that you have——

Mr. ROHRABACHER. Well, I was on the Floor, actually, giving a speech. I apologize.

But just one question. Where does the whole idea of finding a cheaper way of getting things into orbit come into play in commercialization? Do you see that some day we're going to have a situation where private companies can actually run a space operation from launch, all the way through, and back down?

Mr. ROSE. Yes. I think the COMET program, which we have had some discussion on prior to your arriving, we've almost beat it to death, but it is the first step of having a truly commercial operation that goes from payload integration, to launch, to on-orbit operations, to reentry and recovery in the United States done strictly on a commercial contracting basis. The three companies, once they have set up this capability for our CCDS program, they are on their own to market this commercially. We're not through. We believe we've got to continue to drive the cost per pound down, way down; and there are some interesting technologies like hybrid propulsion technology that could offer the opportunity. And so our CCDS at Telahoma, Tennessee, who does propulsion technology work and they are propulsion experts are going to do some technology work in that field and, if it matures, we will use such a stage as a demonstration on a sounding rocket and then maybe as a launch stage for the COMET, and if they say what they can do or is practical to do, we might be able to get the cost per pound down to something in the neighborhood of $2,000 a pound, which is now getting in a range that commercial people might very well be able to afford.

Mr. ROHRABACHER. I think it was Werner von Braun, and I think everyone knows this quote, it was "gravity, we can lick, it is the red tape that's the problem." Well, I would hope that as our technological capabilities progress, that we don't find that in this land of free enterprise that NASA becomes a trap for commercialization rather than someone that's promoting commercialization.

Mr. ROSE. I am totally sympathetic that it is going to be the commercial world and private companies that commercialize space not the Government. Our role is to— there is a Government function to be done, and I believe what we have tried to structure with the CCDS program is a relationship between industry and Government that is the right one. And I think if you would go out and maybe ask the industries who are working through these CCDS's, I think you'll find that perhaps they would agree with that; that we, the Government, in this particular case are approaching it correctly.

The CCDS's are allowed to function like commercial. By them providing the procurement process for the sounding rockets, the COMETs, the Wake Shields, they are avoiding the Government having to impose the Government rules, regulations, all the systems on them. And it is being done in a remarkable fashion. Sounding rocket was put together, the whole idea and competed in three months, and they flew six months after that. COMET has been put together in less than a year, more like nine months, and they will fly in eighteen months. And it's as close to getting it done

through the private sector as you possibly can. And I agree with you that Government has to help, it cannot hinder.

Mr. ROHRABACHER. Thank you very much. Thank you, Mr. Chairman.

Mr. HALL. Sorry, Mr. Stallings, I didn't see you down there. He's gone again. [Laughter.]

The Chair recognizes Mr. Volkmer.

Mr. VOLKMER. Thank you very much.

USE OF SPACE STATION BY CCDS'S

Jim, I am sorry I had to leave but I had other things I had to do and missed out on the rest of your testimony. I'm sure most of the questions have been addressed as to what goes on next year in our commercial use of space. I want to look a little further down. I'm seeing the downsizing of a Space Station and I am just wondering if that Space Station is downsized, with the other demands on it, if we're going to have much in that Space Station for your efforts and the CCDS's efforts.

Mr. ROSE. It is a good question. Let me just say that we have been working with the downsizing activity. Can't do much about the size it is downing to, but I can certainly say that the type of programs that we are projecting through the CCDS's and anticipated industry outgrowth from those CCDS's by the year 1996 time frame, we can use a major—we will be a major user of what space there is available in the laboratories. We see a significant activity in the program. And let me just point out, in the field of microgravity, which is one of the key elements that people recognize as important, along with life sciences, materials processing research—why do we do that? We do that in order to try to enhance the competitiveness of American industry to be able to use that environment to do something.

We intend to have through the CCDS's major industry involvement in a number of product line areas wanting to use the Space Station, and we have already defined some 14.5 racks already of quality hardware that will be matured through our balanced flight program using COMET, sounding rockets, shuttles, SPACEHABs, and right on in to the Space Station. So I think we could easily accommodate some 70 percent of what we think is going to be available.

Mr. VOLKMER. All right. Now——

Mr. ROSE. That doesn't leave a lot for science, but then we should have first crack at it, don't you think?

Mr. VOLKMER. Well, isn't that what you feel——

Mr. ROSE. Because we've got industry; we've got industry with us.

Mr. VOLKMER. Right. You feel that your competition is going to come from—now the big push is that we've got to have maybe almost one space capsule up there that is maybe going to be dedicated to life sciences, I suppose, I don't know how that's going but I know there is a big push on it. I understand it; I understand the need for it. If we're going to go on back and revisit the Moon and go on to Mars, we need to have that knowledge.

What I get a little concerned about is I see the continuation of commercialization use of space maybe being limited. We are on the line right now with the SPACEHABs and everything, what you're addressing, as we go up to build that. And as we do research, we become more knowledgeable, we advance technology, there is a good chance that you're going to have additional demands.

Mr. ROSE. I don't think it is any question we expect that and we're going to put in a darn good case for making sure we'll have a place for these people to continue their operations. You're right, if we build up expectations—and that's what I think we're going to build up—in industry through the type of CCDS work that I see maturing now—last year and what I see has happened this year and what I expect we're going to see happen when I'm here next year at this time, a tremendous build-up of interest beginning to form and industry is beginning to say let's move forward with real applications. We've got to have a place for them to go.

SPACEHAB

Mr. VOLKMER. How long do we plan to have the SPACEHAB up as untethered and then bring it back down again?

Mr. ROSE. SPACEHAB right now is scheduled to fly either in December of 1992 or January of 1993. We right now have leased four—on six flights, the equivalent of four complete SPACEHABS.

Mr. VOLKMER. Now are those all going to come back with the Shuttle?

Mr. ROSE. Yes, they all come back with the Shuttle.

Mr. VOLKMER. We're not going to put any out yet and just let them sit out there for a while and then go get them?

Mr. ROSE. No. Through the development of the vacuum Wake Shield that we have underway now which needs to be free flown outside of the Shuttle, we intend to put additional CCDS payloads on that system because they are amenable to wanting to be in that environment anyway. This will begin to get a system that can stay up as much as 90 days to 120 days and be picked up at a later date by a Shuttle.

Mr. VOLKMER. But we're really not going to have anything before the Space Station for long-term research?

Mr. ROSE. The only long-term we have which we are making provisions for is the COMET program, the new program we just have underway which is an unmanned system that kills two birds with one stone. It is a system we need to do 30-day type experiments that the CCDS's need, but it also is a way to help American industry develop infrastructure and transportation capabilities which they can now market themselves to other users.

Mr. VOLKMER. In other words, with the station and what you are able to use, whether it is you don't have an opportunity for long-term research then.

Mr. ROSE. That is correct.

Mr. VOLKMER. And also applications.

Mr. ROSE. In fact, the early parts of the Space Station, the man-tending parts, tend to have the best of both worlds. You get the man there to do some things you want him to do; then, when he goes away, it is a little bit quieter for microgravity type research.

So we see the first few years of the Space Station as kind of maybe providing the type of environments that we believe our CCDS's believe is what they will be needing in that time frame.

Mr. VOLKMER. Thank you very much. I am going to look forward when we have other testimony from other principals involved and see if we can get some harmony.

ELECTROPHORESIS PROGRAM

Mr. HALL. Mr. Rose, just to try to nail down some things and for the record. Johnson and Johnson dropped its interest not because the ground procedure was better but because it was quicker.

Mr. ROSE. That's correct.

Mr. HALL. And McDonnell Douglas probably followed suit and because of the Challenger accident, which kind of shows the frailty if you're having to hitch a ride on any shuttle that you can get.

What's the likelihood of CCDS experimenters flying some of their experiments on this Soviet Space Station, and why do many in NASA run backward when we mention MIR?

Mr. ROSE. Well, I'm a user; I'm not a provider. In that sense, we want to use—Right now, the CCDS program, as you can see, we use anything that provides us capability to get into space because getting into space is the most critical part of the program.

USE OF MIR SPACE STATION

Mr. HALL. Let me just ask some questions, one right after another. Would the Russians accept us, would they be interested in flying some of our experiments? The Electrophoresis, would they be interested in cooperating on that? Just yes or no.

Mr. ROSE. I would think they would.

Mr. HALL. Then wouldn't it also benefit us—not having no criticism of the change of the Space Station because technology changes and needs change and I think it makes more sense to upgrade if we see a way to better it. The first small TV set I saw was about four inches square and all the workings were in a box this big. We've evolved and I am sure that the needs for the Space Station evolved.

I have the same concerns as Chairman Volkmer has of lessening the space and the availability there. But that, I'm sure, goes hand-in-hand with the problems money-wise at this time. I just wonder if it wouldn't make sense to use MIR and learn from using it as to what size Space Station we need, and how much we would need to allocate to these flights, and benefit from any of their mistakes. At the same time, we seen hell bent for leather to give Russia some money. It might be a good place to buy some time from them and to lease something and let them accept our gifts with dignity. Why isn't that practical?

Mr. ROSE. I don't think it is impractical at all. I am not certain if there are any international limitations by either the State Department or the Department of Commerce or our own agency on relations with the Soviets.

Mr. HALL. France and Germans go up.

Mr. ROSE. The French and the Germans are regular users of the MIR, especially the French. It is access to space and they need access to space.

Mr. HALL. We have to go on their vehicle because we can't dock there and it is a different inclination.

Mr. ROSE. And as far as being able to use that facility, if we were given the permission to go do that, I would imagine we would find quite a bit of interest in that.

Mr. HALL. You'd have some interest in it?

Mr. ROSE. I think so.

Mr. HALL. Are there other questions?

COST-EFFECTIVENESS OF SPACEHAB AND COMET

We do thank you. It has been a very good set of testimony. We thank you for your time. Do you have anything further you'd like to leave for the record? And might we have opportunity to send you questions if we see some things that we haven't covered. I, in my haste, overlooked one thing. I did ask you earlier, your office is requesting nearly double of last year's budget. I guess if NASA as a whole doesn't get its entire budget request, which is not an impossibility, your office will undoubtedly take some hits if you don't get what you've requested. We're here to help do that, but if we're not able to get that that you've requested, since most of the budget increase and nearly half of your total budget is SPACEHAB and COMET, you may have to chose between those two. Are you prepared to do that and, if push comes to shove, which one of these is more valuable?

Mr. ROSE. They both have their natural place in what we're doing. I would hope that we would not try to put us in a position to have to make such a decision.

Mr. HALL. You don't want to say which child you love the most, huh?

Mr. ROSE. Well, they both have their—they are doing different things and they provide different capabilities and they are both important to commercial space.

Mr. HALL. Then how about cost-effective.

Mr. ROSE. They are both extremely—Well, the COMET is very cost-effective from the standpoint of view of helping to set in the United States a capability to provide a commercial service of this nature.

The SPACEHAB is more of a dedicated thing to shuttle. It will also get some international business from it as well.

Let me just point out that we've just signed a service contract, this is not a typical Government type contract, with SPACEHAB. We also have the same kind of arrangement with the COMET. We are buying a service. It is hard to slip things when they are putting the monies up in, especially, SPACEHAB. We had to absorb some termination liability front-end. We had $12 million cut last year which really came out because SPACEHAB had slipped six months. I had a small amount of reserve because we didn't know what COMET was going to cost or SPACEHAB until just within the last two months, for both of them. We have fit into the budget; we are not asking for any additional dollars, but, let me tell you, I

don't have any reserve and something will have to give in this particular year.

Mr. HALL. Well, you will have much support here. I think particularly as you work with industry and the small businesses, and if we could mix in I guess a reassessment of the electrophoresis and the other medical thrusts to make it more acceptable, it would certainly be helpful.

We do once again thank you and——

Mr. VOLKMER. Mr. Chairman.

Mr. HALL. Yes.

Mr. VOLKMER. I wanted to just ask Jim something. The SPACEHAB though is a lot further advanced as far as getting close to fruition than the COMET program.

Mr. ROSE. Well, the COMET will fly before SPACEHAB.

Mr. VOLKMER. It will.

Mr. ROSE. COMET is scheduled to fly in 18 months; SPACEHAB is a little more like—one is in 1992, the other is the end of 1992. They are both coming along basically in the same year but COMET is actually in front.

Mr. VOLKMER. Okay.

Mr. HALL. How much cash contributions from industry to all CCDS's did you have in 1990? Do you have that figure?

Mr. ROSE. Yes. It was equivalent of $35 million in fiscal year 1990. It is anticipated to be $70 million in 1991. It has almost doubled.

Mr. HALL. Can you break that figure down any way?

Mr. ROSE. We can break it any way you like it. A lot of it is in-kind, some in cash, but it is all auditable. The numbers we give you are auditable.

Mr. HALL. You'll break that down and give it to us for the record?

Mr. ROSE. Yes, sir.

[The information follows:]

Total cash contributions from industry in 1990 were $16,282,155, with additional in-kind contributions of $14,826,743. These contributions total $31,108,898 for the year.

Mr. HALL. I really appreciate the earlier visit with you and appreciate your presentation to this subcommittee.

Mr. ROSE. Thank you, sir. We're glad to be here and looking forward to working here with you.

Mr. HALL. Thank you. All right. We will now hear from Mr. Charles T. Force, Associate Administrator for Space Operations. Mr. Force, we welcome you. You want to identify the gentleman to your right. We don't have a marker for him.

Mr. FORCE. I'd be quite happy to do that. To my right is Ron Dapice who is head of Administration and Resources Management Division in the Office of Space Operations. On my left is Jerry Fitts, who is my Deputy, of course.

Mr. HALL. I understand your ground network is in charge of Space Operations. I might just pass on to you that I visited last evening back in Texas with a group from TI who one of their products was the Harm Missile and the BGU-27, or the Paveway, and they, too, were people that operated from the ground and had a

great deal of pride in seeing that very few of their Scuds missed our Patriots and that very few of their bombs—I think less than one tenth of 1 percent—missed the mark during the Iraq conflict. So you men and women who operate the Space Program for us I'm sure have a lot of pride and a lot of satisfaction in seeing success and seeing the achievement. We appreciate you probably more than we tell you so. But we also appreciate you coming before this committee and the time that you've put into it and the time you will give us. We recognize you at this time.

STATEMENT OF CHARLES T. FORCE, ASSOCIATE ADMINISTRATOR, OFFICE OF SPACE OPERATIONS, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, ACCOMPANIED BY JERRY J. FITTS, DEPUTY ASSOCIATE ADMINISTRATOR, OFFICE OF SPACE OPERATIONS, AND RONALD R. DAPICE, DIRECTOR, ADMINISTRATION AND RESOURCES MANAGEMENT DIVISION, OFFICE OF SPACE OPERATIONS

Mr. FORCE. Thank you very much. With your permission, I'll submit my prepared statement for the record.

Mr. HALL. It will be in the record, and you may summarize and then subject yourself to questions, if you would.

Mr. FORCE. I'd be happy to.

Mr. Chairman, I congratulate you on becoming Subcommittee Chairman on Space, and I certainly look forward to working with you now and in the future. It is a real pleasure for me to be here this afternoon to discuss our 1992 budget request with you. You have our detailed request and the accompanying narrative explanation. We acknowledge the fine work of the committee staff and welcomed the opportunity we had to brief them earlier.

Especially for the new members, I would like to take a couple of minutes to explain who we are and what we do. The Office of Space Operations is one of NASA's four program offices. For those who are familiar with the DOD jargon, we are essentially the CQ part of the NASA, the Command/Control/Communications functions. We provide and operate an infrastructure which is just as essential to the achievement of agency objectives as are the more visible elements, such as transportation systems and the many spacecraft now operating beyond the boundaries of our planet. When we do our job right, those who depend on us are not acutely aware of our efforts. Astuteness is necessary on the part of those such as this subcommittee who must recognize the value of and provide for this enabling infrastructure. While you properly call on us to justify our budget request, you have understood the importance of our role. We are very appreciative of your support and are here this afternoon to address any questions or issues you may have concerning our 1992 request.

The Office of Space Operations and its predecessors were organized as a separate office in recognition of two factors: First, very substantial economies are possible if all agency programs share this specialized infrastructure; and second, the establishment of such an essential infrastructure is most effective with separate funding and management. The wisdom of this approach has been demonstrated. NASA's flight programs are dependent on the exist-

ence of this reliable and specialized infrastructure, yet the investment is a modest 6 percent or so of the agency budget.

Our involvement in agency programs ranges from aeronautical flight testing to inter-planetary spacecraft now leaving our solar system. Our capabilities are required in manned and unmanned space flight missions, as well as in balloon and sounding rocket flights conducted from the far corners of the earth. Today we are playing a major role in the mapping of Venus by Magellan, the navigation to Jupiter of both Galileo and Ulysses, scientific studies of the universe by the Hubble Space Telescope, and looking at our planet Earth through the Landsat spacecraft.

We transmit radio frequency signals to spacecraft from ground stations and from orbiting relay satellites, and capture the data they were designed to produce. We do some processing of these data, and transport them around the world to control centers from which the spacecraft are operated, or to the scientists who will interpret their messages. We provide payload operations control centers, and in some cases operate the spacecraft ourselves. We also do command management—the checking of uplinks to spacecraft to ensure that they are proper and do not violate any mission rules.

We track spacecraft in the outer solar system with a precision of 50 nanoradians—the angle between the edges of a salad plate in Los Angeles if you were looking at it from here in Washington. We measure the attitude of spacecraft and compute maneuvers to reorient them as necessary to conduct desired observations. We also operate communications networks to tie all this together. In this regard, we rely on the private sector to provide our communications services—working through the General Services Administration and using FTS 2000 as appropriate.

In terms of facilities, we're responsible for the Tracking and Data Relay Satellite System, or TDRSS; the Deep Space Network; a number of payload operations control centers; the Flight dynamics Facility; a Command Management Facility; several data capture and processing facilities; an operation communications network called NASCOM; a Program Support Communications Network; and facilities for communicating with sounding rockets, balloons, and for conducting aeronautical flight tests.

We operate facilities ranging from stations with giant 70 meter dish antennas in Australia, Spain, and California, to the TDRSS ground station in New Mexico, to a major tracking station at Cape Kennedy which provides primary communications coverage for the critical ascent phase of Shuttle launches. Others include extensive data handling facilities at the Goddard Space Flight Center, and the Program Support Communications Network managed by the Marshall Space Flight Center.

It is worth noting that few, if any, technologies in our world today are advancing as rapidly as those at the heart of our program—communications and information management. Keeping up with these is especially challenging, but these technological advances also provide us the solutions we need to meet the requirements of programs being developed.

Now let me bring you up to date on the status of our major activities. Last year I advised you of a major subsystem failure in TDRS-3 located over the Pacific Ocean. At that time we were look-

ing into the possibility of reactivating TDRS–1 and relocating it to the vicinity of TDRS–3. By using backup equipment at the New Mexico ground station, we have been able to maintain full TDRS capabilities over the Pacific by combining these two partially failed spacecraft. Unfortunately, we are left with no reserves for emergencies, either in orbit or on the ground.

Within a few months this situation will be corrected. TDRS–E is scheduled to be launched this summer. Incidentally, this spacecraft was shipped from TRW in Los Angeles to the Cape early this morning and arrived there just over three hours ago.

Construction of the second TDRSS Ground Terminal, or STGT, is 50 percent complete, on schedule, and within cost. This facility will provide the needed redundancy on the ground, along with the capability to operate additional data relay satellites required in the future.

We have identified our next generation of data relay satellites as Advanced TDRSS, or ATDRSS. These follow-on spacecraft are essential for program continuity, and a new design is needed for both technical and, I emphasize, for economic reasons. The Phase B contracts with three competitors will be completed this summer. We expect to release the Phase C/D RFP late this calendar year. Contract award is projected in early fiscal year 1993. Not only do we expect to launch ATDRSS using ELV launch services, but we are seriously considering accepting delivery on orbit.

Our request for fiscal year 1992 is $976 million. Two- thirds of these funds are needed to continue operating our in-place facilities; one-sixth is for continuing with the remaining two TDRS spacecraft and completion of the STGT. The remaining funds are required primarily to prepare for approved new missions. There are quite a number of these, and the aggregate effect is substantial. As Admiral Truly testified before your committee a month ago, 35 major space science missions are scheduled to be launched over the next five years. Each of these places demands on us in the years before launch as we prepare for the operations phase.

We have made several program changes since I appeared before you last year. At that time, we planned to request 1992 funding to exercise an option for the 8th TDRS spacecraft of the present generation. We are not requesting these funds. In the intervening time, the Agency's schedule for launching the Earth Observing System has slipped, and the Space Station requirements before Permanently Manned Capability have been reduced. Since these were two of the major factors in determining when follow-on TDRS spacecraft would be needed, we were able to drop one spacecraft from our plans.

The Agency also decided to move the launch of TDRS–G, or TDRS–7 after it is deployed in orbit, from the Shuttle to an ELV. This change is consistent with the recommendations of the Augustine Report. The ELV will be procured competitively by NASA's Office of Space Flight.

Consistent with the new EOS and Space Station schedules, we also delayed our plans for implementing the Customer Data Operations Facility which I discussed with you last year. This emphasizes how interdependent our activities are with those of the other

program offices. Our programs complement those of the other offices and must remain in balance with them.

One must also keep in mind the relation between costs and the utilization of an enabling infrastructure. Costs are relatively insensitive to loading. On the other hand, it is difficult to focus reductions in a way that affects only a few users.

In closing, I would like to mention an example of the sometimes subtle, but often significant contributions of our program. We advocate standards in recognition that standardization will pave the way for even more efficient space operations. When one couples this with the fact that we generally lead the world in our specialized area, the result is that we are in fact setting world standards. Indeed, this is the case. Most nations are adopting our standards for aerospace communications and data, and in the process we are enhancing the competitiveness of U.S. industry.

Mr. Chairman, that concludes my remarks. Thank you again for your interest in and support of our program. We would be happy to answer any questions you may have.

[The prepared statement of Mr. Force follows:]

HOLD FOR RELEASE
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BY WITNESS

STATEMENT OF
CHARLES T. FORCE
ASSOCIATE ADMINISTRATOR
FOR SPACE OPERATIONS
National Aeronautics and Space Administration
before the
Subcommittee on Space
Committee on Science, Space and Technology

House of Representatives

Mr. Chairman and Distinguished Members of the Committee: Thank you for this opportunity to present the Space Operations Program portion of the President's Fiscal Year 1992 budget request.

INTRODUCTION

The operational capabilities necessary to meet a broad array of requirements critical to NASA's aeronautics and space flight missions are the responsibility of the Space Operations Program. These functions include:

- Spacecraft operations and control centers;

- Ground and space communications;

- Data acquisition and processing;

- Flight dynamics and trajectory analyses;

- Spacecraft tracking;

- Frequency spectrum management; and

- Applied research and development required new technology.

When viewed as a unit, Space Operations activities are one leg of an interdependent triad that is ***absolutely essential*** to this nation's space programs. Space Operations functions, while often less visible, are no less vital than the other triad legs: the payloads and the space transportation

systems that carry them to their destinations. Mission success is possible only when ***all triad elements*** meet their performance requirements.

SOME ACCOMPLISHMENT HIGHLIGHTS

The Space Operations Program played a vital part in numerous 1990 NASA achievements in space. The program provided a variety of critical functions including operation of control centers, launch, landing, tracking, communications, and data acquisition required for mission success. Space Operations provided operational requirements for three major new missions: Magellan, on its mission to map the surface of Venus; Ulysses, a mission to explore the Sun, and the Hubble Space Telescope. Each of these missions required resolution of spacecraft anomalies, which placed increased operational demands on the system. The multi-mission networks provided continuous tracking, commanding, and communications for on-going missions including six Space Shuttle missions; Galileo in its journey to Jupiter; the Voyagers and Pioneers as they leave our solar system for interstellar space; flight research projects and atmospheric research activities employing balloons or sounding rockets; foreign and cooperative missions; and Earth-orbiting spacecraft monitoring the weather and other environmental phenomenon.

The Tracking and Data Relay Satellite System (TDRSS) constellation, linked to the White Sands Ground Terminal in New Mexico, provides continuous coverage with a full range of communications capabilities for over 85 percent of each user orbit. Especially important is the cost-effective increase in data volume accommodated. This giant step forward makes possible efficient use of and corresponding increases in data returns from user spacecraft.

The Space Network achieved 99-plus percent performance in meeting user mission requirements during 1990. A unique White Sands Ground Terminal configuration was developed that permitted use of two partially functional spacecraft as a fully functional data relay spacecraft in the west location. Performance success was accomplished despite the fact that operating three spacecraft exceeds the rated capability of the White Sands Ground Terminal's architecture.

Hubble Space Telescope (HST) operations were successfully initiated through a dedicated control center and data capture facility. It is the most complex control center developed to date for an automated satellite. This control center effectively handled the early in-orbit operations problems of HST by modifying the ground and spacecraft software which enabled mission success. In addition, special efforts by Space Network personnel were instrumental in solving the HST activation problems associated with Tracking and Data Relay Satellite (TDRS) services during the deployment and orbital verification

phases of the mission. These recommendations and adjustments in procedures and data base changes resulted in successful HST data collection.

The Advanced Tracking and Data Relay Satellite System (ATDRSS) activity is under way with three phase B study contracts. ATDRSS is required to technically and economically provide for continuation of our second generation of Tracking and Data Relay Satellites. The ATDRSS contract will be a competitive selection that will provide essential data necessary to minimize life-cycle costs and to develop transition procedures for integration of new capabilities into the ground terminals without interfering with on-going operations.

The Customer Data and Operations System (CDOS) phase B studies were completed. Two approaches have been identified for meeting the large data handling performance increases needed by Space Station Freedom and Earth Observing System in the late 1990's. This is an important step toward acquisition of the operational data handling and processing system of the future.

NASA Select video service now includes educational and public affairs events in addition to its previous use of broadcasting Shuttle mission operations. It now also provides coverage to Hawaii, Alaska, and the Pacific Basin.

Without the support of this Committee, these and the other NASA accomplishments would not have been possible. We are mindful of this fact and express our sincere appreciation.

UNIQUE ASPECTS

Before presenting the FY 1992 budget details, I will describe some unique aspects of the Space Operations responsibilities to help place them in a broader context. Specifically, they are the ***continuous operations***, the ***multi-mission***, and the ***technology aspects*** of the ***Space Operations role***. Together, they drive our program both in our daily activities and as we prepare for the future.

CONTINUOUS NATURE

First is the ***continuous nature*** of the Space Operations functions. Our network tracking, control, data acquisition, and communication activities do not start or end with a given launch or even a spacecraft mission. For example, network operations continue because Magellan, Galileo, Ulysses, and more than a dozen other spacecraft now in operation are dependent upon the Deep Space Network (DSN). Soon, the Mars Observer spacecraft

and others will join this group. Successful completion of all these missions is not possible without the DSN.

In a similar manner, each Shuttle mission, the Cosmic Background Explorer (COBE), the Earth Radiation Budget Satellite (ERBS), the Landsats, and the Hubble Space Telescope require the Space Network. In the near future, the Gamma Ray Observatory, the Upper Atmospheric Research Satellite, and others will be added to this impressive list of satellites dependent on the TDRSS Space Network to accomplish their missions.

The success of these missions is directly linked to the capability and reliability of the communications and control networks. The control centers are the focal point for spacecraft operations and without them spacecraft could not be operated. The ultimate return on the investment in scientific spacecraft missions is the returned science data, which the data processing facilities prepare for analysis and assure the quality of the data. Within the many ever-present constraints, we must do all that is reasonably possible to assure that these critical networks are adequately staffed, operated, and maintained. Otherwise, ***significant portions*** of this nation's total ***investment*** in space are at risk or cannot be achieved.

MULTI-MISSION ASPECTS

Space Operations exists as a separate program office to facilitate sharing of vital and sophisticated specialized resources required by all space missions. This ***multi-mission approach*** dramatically reduces operational costs. The expense of accommodating new requirements is far less than if new, special purpose facilities were dedicated to each new mission. Conversely, only a small cost reduction may be realized with the completion of a single mission because many other programs remain dependent on the basic infrastructure.

TECHNOLOGY ASPECTS

All spacecraft built today incorporate the latest ***advances in technology*** when possible. But, the rate of technological change varies dramatically from one technical discipline to another. Few, if any, match the advances made in communications, control, and data systems. For example, from Explorer I to Voyager 2, the telecommunications capability increased by an order of magnitude about every two years. These areas of rapidly advancing technology are in the mainstream of Space Operations activities; thus, a substantial effort must be devoted to assure that our capabilities are modernized to keep pace with mission requirements. Capitalizing on these advances accounts for our ability to achieve more without corresponding budget increases. The Space Operations infrastructure must keep pace with the advancing technology in order to ***cost effectively*** fulfill its vital role in achieving this nation's goals in space.

The NASA space program requirements in this decade and beyond demand the increased efficiencies, reliability, and capabilities that are available through the use of new technologies. These must be integrated into the existing networks efficiently and without interruptions to the on-going operations.

We look forward to meeting these challenges by providing the dynamic Space Operations infrastructure needed to cost effectively satisfy the requirements of this nation's space programs.

FY 1992 BUDGET REQUEST

OVERVIEW

The FY 1992 budget request for Space Operations is $976 million.

This amount is approximately six percent of the total NASA request. In FY 1992, we must meet the increasing activity levels of the flight programs, as well as the initial study and development activities for such programs as Space Station Freedom. It is a special challenge to meet these requirements given the constraints of the FY 1992 budget request.

Of the total funding requested, approximately two-thirds is required to operate and maintain the in-place Space Operations facilities. Nearly all of the remaining one-third provides for replenishment of Space Network assets and development of ground systems necessary to meet requirements of the NASA planned space programs. The FY 1992 Space Operations budget request includes $33 million for the final payment to the Federal Finance Bank (FFB).

SPACE NETWORK PROGRAM

The FY 1992 budget request for the Space Network Program is $348 million.

The Space Network provides tracking and communications for Earth-orbital and suborbital missions. Key elements of the network are: the TDRS spacecraft in orbit and under production; the White Sands Ground Terminal (WSGT); the Second TDRSS Ground Terminal (STGT); and the Goddard Space Flight Center's Network Control Center (NCC) and Flight Dynamics Facility (FDF).

SIGNIFICANT ACCOMPLISHMENTS

The significant accomplishments of the Space Network in 1990 were: reactivation and operational use of TDRS-1 to augment the reduced TDRS-3 services; the completion of the critical design reviews of the Second TDRSS Ground Terminal; the initiation of the ATDRSS phase B studies; completion

of TDRS-5 testing; and the 99-plus percent efficiency achieved for six Shuttle missions, COBE, HST, Landsats, and ERBS.

TRACKING AND DATA RELAY SATELLITE ELEMENTS

The launch of TDRS-5 is scheduled for mid-1991. This spacecraft will replace TDRS-3 and TDRS-1 in the west orbital location after deployment and checkout. The TDRS-3 and TDRS-1 spacecraft will then be allocated to the role of spares. The combined capability of these two spacecraft approximate one full functional TDRS spacecraft. The Space Network user service will then be provided by TDRS-4 in the east location and TDRS-5 in the west location.

TDRS-6 is currently in storage. Integration and testing of TDRS-7 have begun. TDRS-6 will undergo final build and testing in 1992. TDRS-7, upon completion of the Integrated System Test, will be placed in storage until launch preparation work is required for a mid-1995 launch.

TDRS-7 LAUNCH VEHICLE

The TDRS-7 spacecraft has been manifested on an Expendable Launch Vehicle (ELV) to improve the Shuttle manifest problem. Competition and selection will be handled by the Office of Space Flight.

TDRS-8 OPTION

The restructuring of the Space Station Freedom and the slip in the Earth Observing System Program permitted the operational need to expand the TDRS constellation to be delayed until 1998. This delay is commensurate with the expected availability on orbit of the first ATDRSS spacecraft. Therefore, the option to procure TDRS-8 under the Replacement Spacecraft is not planned to be exercised.

TDRSS WHITE SANDS GROUND TERMINALS

The STGT Project, initiated to eliminate a critical single point of failure in the Space Network, is progressing on schedule for start of operations in mid-1993. After the STGT becomes operational, the WSGT will be upgraded with identical equipment to minimize life-cycle costs. Each ground terminal will have the capability to support a three-TDRS constellation. The Space Network Control Center modifications to control and monitor the STGT and upgraded WSGT systems are under study. Construction of the STGT 19-meter antenna systems is nearing completion.

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ADVANCED TRACKING AND DATA RELAY SATELLITE SYSTEM (ATDRSS)

The ATDRSS Program will ensure essential and cost-effective continuation of the Space Network into the next decade. The new design is necessary to permit use of cost-effective new technology, which will significantly reduce the cost relative to that required to replicate existing spacecraft. The ATDRSS phase B studies will be completed in July 1991. The decision not to exercise the TDRS-8 option makes the ATDRSS schedule critical to the Space Network's ability to meet commitments late in this decade. The ATDRSS spacecraft are planned to be launched on ELV's and merits of delivery on orbit are being studied. Funding requested in FY 1992 is needed to continue project engineering to finalize spacecraft design requirements; to continue technology assessments for cost- effective tradeoffs; and to continue studying the most cost-effective means of transitioning to the ATDRSS spacecraft while making the necessary ground modifications without disrupting on-going operations.

LATE-1990's TDRS CONSTELLATION REQUIREMENTS

In the late 1990's, additional spacecraft will need to be added to the TDRSS constellation to meet the projected doubling of user single access antenna demand. At that time the TDRS constellation will consist of at least four spacecraft in orbit compared with the three today. We will begin by operating two spacecraft over the Atlantic and two over the Pacific. Spare capability will initially be provided by an extra spacecraft antenna at each location, rather than a centrally located spare spacecraft. However, analysis of this configuration is heavily dependent upon mission requirements developed by the scientific community, and by the functional status of the spacecraft in the TDRS constellation.

The TDRS-3 anomaly serves to emphasize the need to provide adequate spacecraft resources to ensure viability of Space Network operations.

GROUND NETWORKS PROGRAM

The Space Operations budget request for FY 1992 includes $292 million for the Ground Networks Program. Funding for this program provides for operation, maintenance, and engineering of the worldwide tracking facilities. Also included is funding to upgrade the facilities to meet needs of approved new missions.

The Ground Networks provide Earth-based tracking and data acquisition services to NASA's aeronautics, science, and applications missions. There are three major elements of this program: the Deep Space Network (DSN); the

Spaceflight Tracking and Data Network ((STDN); and, the Aeronautics, Balloon, and Sounding Rocket (AB&SR) program.

DEEP SPACE NETWORK (DSN)

The DSN budget request for FY 1992 in $192 million. The DSN provides tracking and data acquisition for a wide variety of interplanetary and some Earth-orbital spacecraft. This network has a world-class capability for receiving transmissions from spacecraft operating in our outer solar system and for performing the extremely accurate measurements necessary to navigate to the outer planets. The DSN is a unique capability. Because of the DSN, the United States is the only nation capable of operating spacecraft beyond the orbit of Mars. For example, the DSN routinely receives data from over seven billion kilometers from Earth. Traveling at the speed of light, data from Pioneer 10, which is mankind's most distant space probe, takes over six hours to reach Earth.

The Magellan and Galileo spacecraft were launched in 1989. Magellan is mapping the surface of Venus, and Galileo will probe the atmosphere of Jupiter and tour its family of satellites.. During the past year, Galileo flew by both Venus and Earth where it received gravity assists for its long journey. The Ulysses spacecraft, built by the European Space Agency as part of a joint mission with NASA, was launched in 1990 to probe the Sun's polar regions. In this and future years, the DSN will provide tracking and data acquisition for these missions as well as for older spacecraft such as the Pioneer and Voyager series.

The DSN also operates, in conjunction with its other activities, one of the largest planetary radar systems in the world enabling scientists to map the surface of Venus and Mars, and to observe the rings of Saturn, asteroids, and comets.

The primary elements of the DSN are three multi-antenna complexes positioned around the Earth at approximately 120-degree longitude intervals. These facilities are located near Goldstone, California; Madrid, Spain; and Canberra, Australia. They provide continuous observations of planetary spacecraft. The network is managed by the Jet Propulsion Laboratory (JPL).

The unmatched capabilities of the DSN have also resulted in our participation being sought in many international cooperative programs.

The DSN is designing a new network of small, 10-meter diameter, automated antennas to cooperatively track both the Japanese (VSOP) and a Soviet (Radiostron) Space Very Long Baseline Interferometry (VLBI) missions. More than ten nations are participating in these missions, which will provide a ten-fold increase in detailed knowledge of extragalactic radio sources such as

quasars. This technique uses a space-borne antenna in combination with ground radio telescopes, and it was demonstrated by NASA scientists in 1986 using the TDRS to view the radio sources. In addition to the three new DSN antennas, the Space Operations Program is providing $3 million for refurbishment of a National Radio Astronomy Observatory antenna at Green Bank, West Virginia, to support the international radio astronomy programs in conjunction with Japan and the Soviet Union.

The FY 1992 DSN budget request of $192 million is slightly more than 65 percent of the Ground Networks budget request. Approximately $110 million of the DSN budget provides for the operation of the facilities. An additional $27.5 million (which is part of the DSN systems budget request) is needed to sustain the operational capability of the worldwide communications complexes and the Network Operations Control Center. Aside from the sustaining engineering discussed above, another $55 million has been requested by the DSN systems program to provide new capabilities to meet the requirements of a large number of new missions. Among the most prominent of these are Mars Observer, CRAF/Cassini, the International Solar Terrestrial Physics Program (ISTP), and TOPEX/POSEIDON. Another major new mission activity in DSN systems is to implement high data rate capability for the once-in-a-lifetime Galileo Probe entry into the Jovian atmosphere, and Galileo's closest approach to Jupiter's moon Io in 1995.

SPACEFLIGHT TRACKING AND DATA NETWORK (STDN)

For over 30 years, elements of the STDN have met the tracking and data acquisition requirements of the unmanned scientific projects as well as the manned space flight program. Unmanned spacecraft have provided a myriad of Earth science observations ranging from global weather data to monitoring of the Earth's crustal dynamics. Today, the residual STDN is required to primarily provide the tracking and data acquisition required for the Space Transportation System (Shuttle) Program. This includes not only critical launch and landing phase requirements, but also extensive prelaunch requirements for checkout of orbiter vehicles and their payloads to achieve launch readiness.

The STDN is comprised of three tracking stations located at Merritt Island, Florida; Bermuda; and Dakar, Senegal. The Merritt Island station covers the initial ascent phase of the Space Shuttle, meeting critical vehicle and integrated payload requirements including astronaut voice communications. This station is also available around the clock for vital prelaunch data communications with Shuttle orbiters and payloads at various stages of integration at Kennedy Space Center. The Merritt Island station performs similar prelaunch and launch functions for Expendable Launch Vehicles and payloads.

The stations at Bermuda and Dakar provide similar critical tracking and communications for the ascent phase of Shuttle and Expendable Launch Vehicle missions. The Bermuda station also performs launch phase range safety functions for the United States Air Force Eastern Test Range and provides on-orbit radar for Shuttle missions. The Dakar station functions primarily as a ground-based backup to the TDRSS Space Network for the critical orbital injection phase of Shuttle missions. All three of the STDN stations are available as backups to Shuttle communications through the TDRSS. When not needed for Shuttle requirements, these stations are used to augment the data acquisition capabilities of other Ground Networks facilities. They are also available for emergency requirements for the satellites normally served by the TDRSS Space Network.

The STDN Program also provides a centralized logistics depot for all elements of the Space Operations Program. The depot provides responsive shipping services necessary for delivering urgent, mission-critical parts to worldwide locations.

The STDN budget request for FY 1992 is $62.3 million, which is approximately 21 percent of the Ground Networks budget request. Of that amount, the STDN operations budget request is $58.7 million and the STDN systems budget request is $3.6 million to sustain the operational capability of the network.

AERONAUTICS, BALLOON, AND SOUNDING ROCKET (AB&SR) PROGRAM

The AB&SR Program provides tracking, data acquisition, and data processing for suborbital research activities and selected Earth-orbiting satellites. The program also provides Shuttle landing telemetry and commanding services from the NASA Dryden Flight Research Facility (DFRF) and Edwards Air Force Base, California. The AB&SR Program also operates a combination of fixed and mobile facilities from DFRF to meet its diverse aeronautical mission objectives.

Mobile and fixed instrumentation systems for tracking, data acquisition, and safety requirements for sounding rocket and balloon launches are operated by the Wallops Flight Facility in Virginia. These systems are used in the operation of a worldwide program of scientific research. The communications facilities at Wallops also track Earth-orbital missions. An enhancement to the Wallops mobile facilities will be used in conjunction with the NASA Small Explorer Program for data acquisition in geographic areas not covered by other Ground Networks facilities.

The AB&SR budget request for FY 1992 is $37.3 million, which is approximately 13 percent of the Ground Networks budget request. Of this, $22.6 million is required to operate the facilities. In addition, funding in the

amount of $14.7 million is required for systems implementation and sustaining activities for mobile radar, communications, and aeronautics tracking equipment at the Wallops Flight Facility (WFF) and the Dryden Flight Research Facility (DFRF).

A tracking facility at the University of Alaska, Fairbanks, is also operated by the AB&SR Program. This facility will receive data directly from two foreign Synthetic Aperture Radar Satellites used to map the Earth's resources. NASA will be receiving data from these satellites as part of its cooperative agreements with Japan and the European Space Agency (ESA).

COMMUNICATIONS AND DATA SYSTEMS PROGRAM

The Communications and Data Systems Program budget request for FY 1992 is $314 million. The elements of the Communications and Data Systems Program form the vital link between the data acquisition stations and the scientific users and project facilities. The requested funds will continue the operation of the following functional elements: two communication networks, spacecraft mission control centers; data processing; and, flight dynamics computations. Other program functions, while minor in budget requirements, are nonetheless important. They include management of the Agency's use of the radio spectrum and development of advanced data systems standards for future space missions and data processing systems.

COMMUNICATIONS

The Communications Program provides two Agency-wide communications networks. The real-time Space Operations communications are provided by the NASA Communications (NASCOM) Network. This global network interconnects NASA's foreign and domestic tracking and data acquisition stations; NASA's launch complexes, mission and network control centers; NASA's field centers; and international partners. It is designed to provide very high reliability and carefully controlled access to protect our space assets.

A program is being defined to increase NASCOM capability to meet the higher data rates and volume requirements of NASA missions scheduled in the last half of this decade. A new fast-packet technology using a fiber-optic backbone is being considered. The specifications will be completed this fiscal year.

The NASA Select video service continues its broadcast of Shuttle mission operations, educational and public affairs events, and coverage to Hawaii, Alaska, and the Pacific Basin.

NASA's non-operational data delivery and administrative communications requirements are provided by the Program Support Communications

Network (PSCN). This network connects all NASA field centers, major contractors, scientific investigators, and provides access to commercial network services. In FY 1992, the PSCN will continue to service NASA programs and projects, such as the Space Shuttle, Space Station Freedom, and other science programs. In FY 1992, NASA's leadership in the use of video teleconferencing will continue to increase accessibility and to economically accommodate additional users.

MISSION CONTROL AND DATA SYSTEMS

The Mission Control Program provides the control and performance analyses of NASA's unmanned Earth-orbiting spacecraft. These control facilities are the only means of instructing the spacecraft to make observations and measurements. The Multi-Satellite Operations Control Center (MSOCC) is employed for those missions compatible with shared use of a facility. More complex missions such as Hubble Space Telescope (HST) or those requiring continuous real-time control such as the International Ultraviolet Explorer (IUE) require separate dedicated control centers. In FY 1992, five control centers will monitor and control 11 orbiting spacecraft, of which Solar, Anomalous and Magnetospheric Particle Explorer (SAMPEX), Upper Atmospheric Research Satellite (UARS), and Extreme Ultraviolet Explorer (EUVE) are new launches in FY 1992.

Development efforts will continue for future missions, such as the Total Ozone Mapping Spectrometer (TOMS), X-Ray Timing Explorer (XTE), Small Explorer (SMEX), Advanced Composition Explorer (ACE), Advanced X-Ray Astrophysics Facility (AXAF), the HST maintenance mission, and the many individual missions of the International Solar Terrestrial Physics (ISTP) Program. Seven of these missions are new activities beginning in FY 1992. These preparations consist of developing software, data bases, and procedures for an existing infrastructure of control facilities that are unique for each mission.

Two major types of activities are funded within the Data Processing Program: capture and processing of spacecraft data, and performing highly specialized computations required for flight dynamics. The latter includes trajectory design, orbit determination and adjustment, and spacecraft attitude determination.

Flight dynamics and mission support for in-orbit free flyer spacecraft and Shuttle-attached payloads will continue, including support to the International Ultraviolet Explorer (IUE), International Cometary Explorer (ICE), Earth Radiation Budget Satellite (ERBS), and Cosmic Background Explorer (COBE). In FY 1991, launch and mission operations requirements on the flight dynamics system were extended to include the Gamma Ray Observatory (GRO). In FY 1992, it will include UARS, EUVE, and SAMPEX.

The Space Station Freedom and Earth Observing System together require data processing at rates between 100 and 1000 times those handled by today's communications and data processing systems. To meet this challenge, NASA has completed phase B studies of a new system, the Customer Data and Operations System (CDOS). CDOS will employ a new concept and system architecture to economically provide the required performance. It will be constructed largely of commercially available components. These components will consist of small high-performance computers and very-large-scale-integrated circuits. Design and implementation of CDOS will begin in FY 1992.

NASA's space flight missions, including manned, unmanned, near-Earth and deep space, require carefully planned and efficient use of limited radio frequency spectrum resources. These resources are controlled and allocated through the regulatory structure of the International Telecommunication Union (ITU) and associated World Administrative Radio Conferences (WARC). A WARC is scheduled for February 1992, and NASA is sponsoring several initiatives to secure frequency bands critical to the success of our future programs. NASA recognizes that the radio spectrum is a limited resource for which there is ever-increasing demand for new services. We have and will continue in the future to take the initiative in identifying opportunities to share our use of the spectrum with compatible commercial or government services.

Development and application of data systems standards is another important element in the Space Operations Program. Such standards can significantly improve system performance and reduce costs by eliminating the need for mission-unique facilities and procedures for network operations and data processing. Through advanced data systems standards, similar functions and services are made available to all missions using systems designed to satisfy requirements of any mission adhering to the accepted standards. NASA chairs the Consultative Committee for Space Data Systems (CCSDS) through which the world's space agencies are reaching agreements on how to design our future data systems for compatibility and greater capability.

ADVANCED SYSTEMS PROGRAM

In the Space Operations Research and Development budget, $22 million is for the Advanced Systems Program. The Advanced Systems Program continues its specialized Research and Development efforts on anticipated but unavailable technology to focus on assessing and employing technological advances in telecommunications, electronic micro-circuitry, and computer sciences. These efforts are essential for the cost-effective application of new technology to meet future mission requirements. On-going work includes investigations of the data transfer and processing needs of future missions,

studies of telecommunication links and ground systems to determine effective design approaches, and overall trade-offs for the lowest life-cycle costs for future space mission communications.

Current work includes investigations of new frequency bands, data processing needs of future missions, and improved navigation techniques. During FY 1991, development of the Big Viterbi Decoder will be completed; this equipment will be used to achieve a substantial improvement in the Galileo telemetry data rate. Similarly, Very Long Baseline Interferometry (VLBI) techniques are expected to achieve new levels of very high angular accuracy tracking, on the order of five nanoradians, which is equivalent to eight-tenths of an inch resolution at a transcontinental distance of 2,500 miles.

The FY 1992 effort will continue studies and developments in use of higher frequencies (Ka-band and optical), in order to increase the data rates for space missions. Other work will focus on improving the position location and navigation accuracy for Earth-orbiting spacecraft to the level of a few centimeters and on developing the highly stable frequency standards so essential to deep space navigation. Finally, a major area will be improvements in mission operations and control center technologies, through increased application of automation, expert systems, and artificial intelligence.

CONCLUSION

The request of $976 million for FY 1992 is essential to meet the challenges on the horizon. These include: continued TDRS spacecraft production; implementation of the vital Second TDRSS Ground Terminal; and completion of design studies for the Advanced TDRSS spacecraft to sustain the Space Network for future missions. These challenges also include continued operation of the mission control and data capture system required by the Hubble Space Telescope and other missions, systems planning and preparation for the Space Station era, and continued network preparation for Mars Observer and other future missions.

Emphasis is focused on sustaining our Space Network by providing redundancy in the ground terminal and by ensuring TDRS spacecraft availability. The Deep Space Network will gain new capability through advancements in technology, including a 10-meter orbiting VLBI network which will operate at Ku-band frequencies. The Communications and Data Systems Program is planning significant upgrades to meet the operational requirements of the Space Station era. The Advanced Systems Program is continuing its focus on assessing and employing technological advances required for future missions.

As the 21st century draws near, the space operations community must prepare for Space Station Freedom, the Earth Observing System, the Great Observatories, and other challenging projects such as the human exploration missions of the Moon and Mars. Technically superior, responsive, and cost-effective space operations are essential to achieve the objectives and benefits of future missions.

To attain the objectives of these exciting NASA programs, the Space Operations Program must be sustained and supported. I urge the Subcommittee's full support of NASA's budget. As NASA's space flight programs are dependent upon space operations' objectives, we, in turn, are dependent upon NASA's institutional program. Your support is also urged for this important budget activity.

Mr. Chairman, members of the Committee, this concludes my statement. Thank you for this opportunity to discuss with you NASA's Space Operations Program.

Mr. HALL. Mr. Force, thank you. And we will have some questions. I guess to start with I'd tell you I have good and bad news for you. The bad news is Mr. Nagle is back here with the committee. And the good news is he'll just have five minutes. [Laughter.]

He's our chief cross-examiner of the subcommittee. I recognize Mr. Nagle at this time.

VOYAGER UPDATE

Mr. NAGLE. On behalf of the committee, and I think only because nobody else was available to go, Mr. Nelson sent me out to the Jet Propulsion Laboratory for the Voyager encounter with Neptune. And at that time JPL was concerned over the shutdown of communications link with the Voyager once it passed Neptune. It was originally scheduled for shutdown, and then, if recollection serves me right, we kept that alive and we're still in contact with it. Now, what is the status of it in your budget, and what's the status of it generally in terms of the communications? I know I should talk to JPL about this too, but can you update me from your perception?

Mr. FORCE. Certainly. The spacecraft is alive and well and we are in communications with it daily. The United States, alone in the world, I might add, has four spacecraft in the outer solar system—the two Voyagers and Pioneers 10 and 11. Our 70 meter antennas, which I mentioned earlier, are used to communicate with these spacecraft. Pioneer 10, for example, is so far out that even at the speed of light it takes radio waves six hours to reach it. Voyager II is a little bit closer.

Mr. NAGLE. Not much, is it?

Mr. FORCE. It's about I think four-and-a-half hours light time.

Mr. NAGLE. Yes. I was thinking of the time link communications when we were out there. I don't remember what the gap was. That was two years ago; I'm sure it's——

Mr. FORCE. It keeps moving.

Mr. NAGLE. Yes. Go ahead.

Mr. FORCE. The limitation we have right now is simply the competition for those antennas among the mission sets that are dependent on them. And the ones that need these antennas the most are the ones in the far solar system. But the mode of operation is such that we're able to communicate with each of them several times a day.

The two Voyagers and Pioneer 11 are on one side of the sky, and Pioneer 10 is alone on the other side of the sky, leaving the solar system in the opposite direction.

Mr. NAGLE. Are you still getting data back from them?

Mr. FORCE. Yes, we are. In fact, the primary objective, particularly with the Pioneers, is to look for the boundaries of the heliopause, which is the bubble, if you will, that surrounds our solar system. And none of them have encountered any indication of it yet, but they are looking at fields and particles type data.

Mr. NAGLE. How far is it beyond Neptune now?

Mr. FORCE. I would have to check into it, sir; I don't know.

[Information requested by Congressman Nagle follows:]

Voyager 1 is 1.3 billion miles beyond Neptune, and Voyager 2 is .5 billion miles.

Mr. NAGLE. And those programs are still funded in your current request now—receiving the data, and et cetera, et cetera are still funded?

Mr. FORCE. That's true. However, the spacecraft, the data analysis is in Doctor Fisk's budget. So our job is handling the communication with the spacecraft, getting the relay back to the ground, and then giving it to him. And our part of that is funded.

Mr. NAGLE. And do you know——

Mr. FORCE. So far as I know, his is. I've had no indication that he didn't need our support.

Mr. NAGLE. Well, there was concern out there about it at the time I was out there, when we actually had the actual encounter, and I just wanted to check on the status of it.

These projected missions we're going to have in the decade of the 1990s, your ability to receive the information from those space projects, I think I saw 30-some.

Mr. FORCE. That's right.

Mr. NAGLE. Are you comfortable that your budget will give you the room for growth to handle that?

Mr. FORCE. If the level that we requested is provided, it is.

Mr. NAGLE. Good. Thank you. That's all I have.

Mr. HALL. Mr. Rohrabacher.

Mr. ROHRABACHER. Thank you, Mr. Chairman.

OMB CUTS IN NASA REQUEST

Mr. HALL. OMB made some large cuts in NASA's—I'll ask you a friendly question first. They made some very large cuts, did they not, in NASA's original request for the Office of Space Operations?

Mr. FORCE. Yes, they did.

Mr. HALL. They cut, what, $92 million from Communications and Data Systems account.

Mr. FORCE. The total, as I recall right now, was $151 million.

Mr. DAPICE. It was $88 million.

Mr. HALL. Eighty-eight instead of ninety-two. You want to comment on that without using any profanity or anything? [Laughter.]

Mr. FORCE. Thank you. I mentioned earlier that there has to be a balance between——

Mr. HALL. What reason did they give; I guess that's what I'm asking.

Mr. FORCE. Okay. As I said, there has to be a balance between our program and the others. The activities which were slipped were primarily related to the slippage of the EOS program and both a slight slippage and a downscoping of the requirements from the Space Station program. These enabled us to slip the Customer Data Operations Service; it also enabled us to drop the eighth TDRS spacecraft, the option that I mentioned. So the major part of our response to that negotiation was to take out these capabilities or delay these capabilities. Both were consistent with actions elsewhere in the Agency.

Mr. HALL. Do the cuts endanger, in your opinion, the offices' ability to support the scheduled space missions?

Mr. FORCE. No, sir.

Mr. HALL. Okay. And you're confident that you'll be able to handle the data from the EOS system given the budget that you're given?

Mr. FORCE. Yes and no. The budget that we were given basically had the money taken out in 1992. And so with the schedule for EOS slipping, we could afford to not start in 1992. So, in that sense, the issues have not really been addressed yet.

Mr. HALL. But you want to replace some old, inefficient equipment and purchase some new equipment that I think testimony indicated that it would be cost-effective in the long-run.

Mr. FORCE. That's true.

Mr. HALL. And you're not going to be able to do that with the cuts as they exist at this time?

Mr. FORCE. That's true. That's a somewhat myopic view, but we're all sort of forced to do that.

DECISION TO LAUNCH TDRS ON EXPENDABLE LAUNCH VEHICLE

Mr. HALL. That's my friendly question and a semi-friendly question is for several years this committee has been urging NASA to launch Tracking and Data Relay Satellites on expendable launch vehicles instead of the Space Shuttle. And NASA has now decided to launch TDRS flight 7, the last of the series, on an expendable launch vehicle; correct?

Mr. FORCE. Correct.

Mr. HALL. Why did they finally get around to making this decision, and why did it take you so long?

Mr. FORCE. There is a long history with NASA and the Administration taking somewhat different views of this. I might add that the Congress has also been a participant in this. As I recall, in our 1989 request we asked for funding to put one of these——

Mr. HALL. So it was a joint effort, huh?

Mr. FORCE. That's right, it has been a joint effort, sir. The funding was deleted by the appropriations explicitly so we were not able to move it off the Shuttle. A year ago when we were asked a similar question, our position was it was not cost-effective to do so.

This time, I think that fact remains. We do not feel it is a cost-effective move. On the other hand, because of a number of the pressures, because of the Augustine Recommendations, particularly, to cut the flight rate on Shuttle; and, secondarily, to take off the Shuttle vehicles which do not require the presence of man, we have made that change this year. And the funding is being requested in Doctor Lenoir's budget for the ELV.

Mr. HALL. What did you have to do to render it an expendable launch vehicle? What modifications were required?

Mr. FORCE. That has to be determined yet. As I mentioned in my comments, the Office of Space Flight expects to go out competitively to select that vehicle. Should the winner be, say, a Titan 3-IUS, the modifications are fairly minor and consist of changing the resonant frequencies of some of the appendages in the stowed position. Should the competition be something else, such as say an Atlas Centaur, then part of that analysis of the offer will have to be an assessment of exactly what those modifications are and what they

will cost. All of these factors will be taken into account in the selection.

Mr. HALL. Do you know when that will be done?

Mr. FORCE. The RFP is being developed right now. It will be going out from the Lewis Center, and I think it is within a matter of a very few months. I can verify that, if you like.

Mr. HALL. If you would.

[The information follows:]

The NASA Lewis Research Center, which will manage the procurement of expendable launch vehicles for the TDRS–G mission, anticipates release of the Request for Proposals (RFP) in May 1991. Contractor selection is targeted for September 1991, with final contract award in December 1991.

ADVANCED TDRS

Mr. HALL. How much time is NASA allotting itself to review the proposals it receives from companies who are making an effort or seeking to contract to develop and build the advanced TDRSS?

Mr. FORCE. Unfortunately, I think I had that question last year and my view hasn't changed. I think it's too long. The specific answer is essentially a year from the release of the Phase C/D RFP until the award of the contract.

Mr. HALL. If it is a well-defined operational program, why would it take that long?

Mr. FORCE. The problem is related more to the procurement process. This is an issue we've been working with the Center involved. The Deputy Administrator is actively involved in this, interested in it. In fact, he has an initiative going across the Agency called Acquisition Streamlining to try to bring these times down. We still have hopes we're going to be able to reduce the time. It is driven more by—

Mr. HALL. That's not totally up to you, is it?

Mr. FORCE. That's right, sir. And it's driven more by——

Mr. HALL. And I think you'd like for me to ask you the next question. What's the typical length of time within Government and within the commercial ComSat industry for reviewing such a proposal? And a follow-up on that as to whether or not any of the Advanced TDRS bidders might reduce their price if Government could make its decision not in 12 months but say in 3 months?

Mr. FORCE. I doubt—I'm sure they'd be quite thrilled to see us do that because they, of course, have to keep the team together during this selection period.

In terms of the level of effort spent between the Phase B activity and the Phase C/D award, it is a fairly small percent I would believe of the overall program. That's not to say that I don't think for other reasons we should indeed try to cut the time. In fact by dropping the option for the F–8 spacecraft, we become even more dependent on having the Advanced TDRS delivered on schedule.

Mr. HALL. Mr. Rohrabacher, do you or Mr. Nagle have other questions?

Mr. NAGLE. No, Mr. Chairman.

Law Regarding Commercial Space Launches

Mr. Rohrabacher. One question. You were talking about the TDRS-7. Isn't the decision basically—aren't you pretty well mandated that this is not to be on a Shuttle mission? I mean, this is a mission that is supposed to be, but don't we have a law that requires you to launch these things on commercial space launches?

Mr. Force. The law, as I understand, says unless other compelling circumstances as determined by, among other things, the NASA Administrator, apply. The determination in the case of the original TDRS series of six, plus seven, which is the one you addressed, is that because of the investment in the Shuttle associated launch capability, the procedures, the reliability, and all that, and the time required to change, that we would indeed not change for the first series. We've definitely—We said long ago we would put the follow-on series on ELVs. The change we have made within the last few months is to plan to move F-7 from Shuttle to an ELV.

Mr. Rohrabacher. I was just under the impression that we were now operating under a law that—we passed a law two years ago requiring that. I'll just have to look back and see if our interpretations and what it applies to are different.

Mr. Force. Well, I think it is. The decision is not cavalierly made. We reviewed all the circumstances and, indeed, have reviewed by Doctor Lenoir's Flight Assignments Board as to what was the appropriate time to make a change. We've never challenged moving the data relay satellites from the Shuttle, the question has only been at what stage was it prudent and effective to do so.

Mr. Rohrabacher. Okay. Thank you very much.

Mr. Hall. I have the legislation if you want to review it. And you may want to frame some questions for Mr. Force to answer later for you.

Mr. Rohrabacher. Let me reserve the right to ask you some questions in writing.

Mr. Force. Surely.

Mr. Rohrabacher. Thank you.

Mr. Hall. Do you care to comment on the Augustine Committee's recommendation that NASA split the Office of Space Flight into a Development Office and an Operations Office and what effect that will have on you and your operations?

Mr. Force. Well, one subordinate element of that was a recommendation that the tracking and data functions be incorporated into the operations element. And Doctor Lenoir and I have a task from Admiral Truly to make some recommendations for him on that and a timetable to do that within the next several weeks.

Mr. Hall. Do you have anything additional that you'd like to say for the committee? And would you allow us the right to submit you some written questions and ask you and Mr. Fitts and Mr. Dapice to answer those?

Mr. Force. We certainly would be happy to answer them.

Mr. Hall. Well I may have some for you.

With that, if there are no further questions, we thank you very much for your time and appreciate the work that you put into the presentation and the work you are doing.

With that, we will adjourn.

[Whereupon, at 3:15 p.m., the subcommittee adjourned, to reconvene at the call of the Chair.]

1992 NASA AUTHORIZATION

WEDNESDAY, MARCH 6, 1991

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON SPACE,
Washington, DC.

The subcommittee met, pursuant to notice, at 1:30 p.m., in room 2318, Rayburn House Office Building, Hon. Ralph M. Hall [chairman of the subcommittee] presiding.

Mr. HALL. All right. The Subcommittee on Space will come to order.

Today we will continue our series of hearings on the Administration's fiscal year 1992 budget request. The focus of our hearing today will be space transportation—a subject and capability that is at the heart of almost everything else we do in space.

We are pleased to have as witnesses today Doctor William B. Lenoir, Associate Administrator of NASA's Office of Space Flight; and Ms. Stephanie Lee-Miller, the Director of DOT's Office of Commercial Space Transportation.

The importance of space transportation I think is reflected by the fact that it accounts for more than $5.5 billion of NASA's overall budget request for fiscal year 1992—the largest single amount of the budget consumed by any individual NASA activity. Clearly, without adequate space transportation support, all other NASA space activities would be stymied.

But the very importance though and the high cost of space transportation I think makes it imperative that the Administration and the Congress make the correct decisions regarding the choices that are before us. This year, these decisions involve choices concerning the development of new boosters, improvements to existing launch systems, and maintaining production support for the Space Shuttle Orbiters.

Our decisions will not be easy ones to make. But we hope that this hearing today will begin to build the kind of record that will be needed for us to reach informed decisions and to make wise decisions.

I could note, Doctor Lenoir, as I am sure you know, the 12th of next month will mark the 10th anniversary of the first launch of the Space Shuttle back in 1981. I just had lunch today with Mrs. Olin Teague, whose husband saw the dawn of space, took me to my first lift-off back sometime in the 1960s; a program that launched up to 60 flights per year to now down to 16, to 14, to 12, to 8, and now back to 10. I think that this is an important year and a salient year and a year that we have to make the right decisions to contin-

ue the respect and admiration that this Nation has for the program that you helped to ride herd on.

So as we move into the next decade, I hope that the Space Shuttle program will achieve an increasing level of maturity. This could include initiatives to begin to bring efficiencies and economies into the program that have not been possible I'm told in the past. However, as always, it is imperative that these efficiencies be brought to bear in a manner that will have no detrimental effect on the quality and, perhaps most important of all, the safety of the program.

And in Ms. Lee-Miller's area of responsibility, we will be discussing issues related to the licensing and regulation of the commercial launch vehicle industry.

I would really like to thank the two witnesses who will be with us today for their presence and for the testimony that they will be offering. And we're honored to have Michael Lyons flanking Doctor Lenoir, and, always, Captain Crippen, it is an honor to have you in our midst.

Before commencing with the testimony, I want to recognize our very able, capable, and thorough ranking republican member of the subcommittee, Mr. Sensenbrenner, for any remarks that he would like to make.

Mr. SENSENBRENNER. Thank you very much.

First of all, I would like to ask unanimous consent that this hearing be photographed pursuant to the committee rules.

Mr. HALL. Without objection, so ordered.

Mr. SENSENBRENNER. Mr. Chairman, I think this is probably the most key of the hearings that we're going to be having on the fiscal year 1992 NASA Authorization budget, because, as the Chairman so correctly states, space transportation is at the core of practically everything NASA does in space.

The Augustine Commission Report I think set out a good guideline for setting up priorities at both the NASA level and the congressional level on the Space Transportation program for the next decade, or even longer than that. But the Augustine Commission Report did have some ambiguities which we would like to have NASA help us resolve.

One of the major ambiguities that the Augustine Commission Report created was, first, in calling for a new unmanned heavy-lift launch vehicle, which is something that this committee has pushed for; but secondly, not telling us how this heavy-lift launch vehicle would fit in in the plans to launch the Space Station. As we all know, the redesign of the Space Station is just about completed, and that was done pursuant to congressional mandate. And I would hope that Doctor Lenoir and Captain Crippen and Mr. Lyon would be able to tell us whether the heavy-lift launch vehicle would be prepared and on-line, ready to take part in the launch of the redesigned Space Station, or whether the heavy-lift launch vehicle would be used for post-Space Station space probes.

Secondly, would NASA be prepared to delay the deployment of the Space Station, waiting for the heavy lift launch vehicle to come on line.

I think if we get some very clear answers to these questions, we will be in a much, much better position to make the essential budg-

etary decisions that we have to make, as well as to fit things into their proper place, which is something that Mr. Augustine and his commission gave us a good start on.

So I look forward to listening to Doctor Lenoir's testimony, and I hope that he hits on these questions because they are very important to be answered.

Mr. CRAMER. Doctor Lenoir, we will go ahead and proceed with your opening statement. The buzzers went off so you are going to see members leaving to go vote, so we are going to rely on you here, but we would like for you to go ahead and start.

Mr. SMITH. Mr. Chairman, is there going to be time now for additional opening statements or not?

Mr. CRAMER. Surely.

Mr. SMITH. Okay. I'll make it brief. Thank you, Mr. Chairman.

Today's hearing is especially important because of the role space transportation plays in the overall goals of NASA. The United States' capability to undertake space science and space exploration missions all depends upon a capable, reliable space transportation system.

The Augustine Commission has suggested the development of a new heavy-lift rocket. Yet, NASA's budget outlook for the next several years seems to leave little room for growth. That is why I suggest NASA take a hard look at using technologies currently within its grasp in developing a new heavy-lift vehicle.

The Apollo program created a very capable and 100 percent reliable engine for lifting its heavy rockets to orbit. Now I understand that the plans and technology for this engine have not been thrown away and that several of these engines exist in storage. I also understand that it would take only a fraction of the time and cost of developing a new engine to bring this engine back into production. Although the engine might not be pushing the cutting edge of technology, it is safe, it is reliable, and it exists. I urge NASA to consider this option, especially given the budgetary constraints that we all live under.

Thank you, Mr. Chairman.

Mr. CRAMER. Thank you. Doctor Lenoir we'll go ahead and start. We are glad to have you here today. I am a new member from Huntsville, Alabama, and it gives me great pleasure to welcome you here today.

Please proceed.

[The prepared opening statements of Mr. Hall and Mr. Smith follow:]

OPENING STATEMENT

OF THE

HONORABLE RALPH M. HALL, CHAIRMAN

SUBCOMMITTEE ON SPACE

March 6, 1991

Today we will continue our series of hearings on the Administration's Fiscal Year 1992 budget request. The focus of our hearing today will be space transportation -- a subject and capability that is at the heart of almost everything else we do in space.

We are pleased to have as witnesses today: Dr. William B. Lenoir, Associate Administrator of NASA's Office of Space Flight; and Ms. Stephanie Lee-Miller, Director of DOT's Office of Commercial Space Transportation.

The importance of space transportation is reflected by the fact that it accounts for more than $5 1/2 billion of NASA's overall budget request for Fiscal Year 1992 -- the largest single amount of the budget consumed by any individual NASA activity. Clearly, without adequate space transportation support, all other NASA space activities would be stymied.

But the very importance and high cost of space transportation makes it imperative that the Administration and the Congress make the correct

decisions regarding the choices that lie before us. This year, these decisions involve choices concerning the development of new boosters, improvements to existing launch systems, and maintaining production support for Space Shuttle Orbiters.

Our decisions will clearly not be easy ones to make. But we hope that the hearing today will begin to build the kind of record that will be needed for us to reach informed decisions.

I could note, Dr. Lenoir, as I'm sure you know, the 12th of next month will mark the 10th anniversary of the first launch of the Space Shuttle back in 1981.

As we move into the next decade, I hope that the Space Shuttle program will achieve an increasing level of maturity. This could include initiatives to begin to bring efficiencies and economies into the program that have not been possible in the past. However, as always, it is imperative that these efficiencies be brought to bear in a manner that will have no detrimental effect on the quality and safety of the program.

In Ms. Lee-Miller's area of responsibility, we will be discussing issues related to the licensing and regulation of the commercial launch vehicle industry.

I would like to thank the two witnesses who will be with us today for their presence and for the testimony that they will be offering.

Before commencing with your testimony, Dr. Lenoir, I would like to recognize the Ranking Republican Member of the Subcommittee, Mr. Sensenbrenner, for any remarks that he would like to offer.

OPENING STATEMENT BY REP. LAMAR SMITH
SUBCOMMITTEE ON SPACE
MARCH 6, 1991

Thank you, Mr. Chairman.

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The Augustine Commission has suggested the development of a new heavy lift rocket. Yet NASA's budget outlook for the next several years seems to leave little room for growth.

This is why I suggest NASA take a hard look at using technologies currently within its grasp in developing a new heavy lift vehicle.

The Apollo program created a very capable and 100% reliable engine for lifting its heavy rockets to orbit.

I understand that the plans and technology for this engine have not been thrown away, and that several of these engines exist in storage.

I also understand that it would take only a fraction of the time and cost of developing a new engine to bring this engine back into production.

Although this engine might not be pushing the cutting-edge of technology, it's safe, it's reliable, and it exists.

I urge NASA to consider this option given the overall budget constraints.

QUESTIONS FOR THE RECORD

1) What is NASA's plan to develop the Assured Crew Return Vehicle recommended by the Augustine Panel?

2) Does NASA plan to develop this vehicle so that it might provide a two-way capability to reach Space Station Freedom?

3) Does NASA still plan to pursue a low cost solution for the ACRV requirement?

4) What is the expected development cost for the Space Transportation Main Engine for use in the Advanced Launch System? How long do you expect the development of this new engine to take?

5) What do you expect the per unit cost of this new engine to be?

6) In what ways will the performance of this engine exceed that of the F-1 engine used on the Saturn V?

7) Has NASA looked into the option of reopening the F-1 production line? If not, why?

STATEMENT OF DR. WILLIAM B. LENOIR, ASSOCIATE ADMINISTRATOR, OFFICE OF SPACE FLIGHT, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION; ACCOMPANIED BY ROBERT CRIPPEN, DIRECTOR OF SPACE SHUTTLE, OFFICE OF SPACE FLIGHT; AND MICHAEL LYONS, DIRECTOR OF FLIGHT SYSTEMS, OFFICE OF SPACE FLIGHT

Dr. LENOIR. Thank you very much. I would like to submit my testimony for the record and then accompany that with a brief opening statement, if I might.

Mr. CRAMER. Certainly.

Dr. LENOIR. Let me first start by reminding us that the Office of Space Flight is not only the Space Shuttle but it also has an arm that we call Flight Systems. Mike Lyons is the Director of our Flight Systems, which includes our expendable launch vehicle activities, the Spacelab portion of the Space Shuttle, as well as upper stages in our other activities such as the tethered satellite and advanced programs.

Bob Crippen, on my right, is our Space Shuttle Program Director. Dick Kohrs, who is not here today, we will have his Space Station hearing I understand later, is part of the rest of the Office of Space Flight then, which is the Space Station itself.

I would like to spend a few minutes, but before I do, I would like to state for the record that we have an ambitious and challenging program ahead of us in the Office of Space Flight and in NASA. And we flat cannot do it without your active support and your help. And we're here today to tell you what we are looking for and to hopefully secure your support and help as we go through this.

A brief status of where we are, trying to bring the news up-to-date, if you like. On the Space Shuttle, as you know, last week we decided to roll Discovery back based on some failed components in the umbilical doors that must close after we separate from the tank. And you have probably read recently that we've discovered some very small hairline cracks on the Atlantis vehicle which is about to go fly. All of that is true, although these small hairline cracks are different activities, different manifestations if you like, than the total separation that we had on the Discovery.

Nonetheless, we are going through our engineering analysis to make doubly sure that we are comfortable to go fly before we roll out of the Orbiter Processing Facility, and that's the activity that you're probably reading about now. We would anticipate rolling out probably early Friday morning.

As you know, the Space Station has been through a restructuring assessment and we are at the closing end of that assessment, we are in the final stages of our discussions of that with the National Space Council and the staff of the National Space Council, and we would anticipate having our final report to the Congress of the United States before we're too far into April. Actually, our goal is to try to beat that by several weeks, but we've set ourselves a requirement by the 8th of April.

And then, finally, on the new launch system that the NASA and the DOD are jointly working to define in response to a National Space Council requirement, is also on the final stages of coming to closure on our assessment of options and recommended programs

that we would anticipate taking back to the Space Council in the next several weeks. I'll say a few more words about that and I would anticipate questions will draw me more deeply into it.

Let me first start by looking backwards and recounting our accomplishments over the last year. In the Shuttle flights arena, we have a whole series of flights for which we can be quite proud. Let me name just a few.

The Long Duration Exposure Facility, known affectionately to all of us as LDEF, was indeed recovered after years in space. It is becoming a veritable treasure trove of information that helps us, with the Space Station program, among others, concerning long duration stays in space.

The Hubble Space Telescope was deployed very successfully from the deployment point of view. One of the advantages of having deployed it and having worked, as we did, to back it up—as you know, it was deployed from the Space Shuttle and we had crews standing by if need be to get in space suits and go outside and repair it—we're quite comfortable with the operations required to reservice it and to repair it and to add modifications to it in several years when we revisit it for the first time

Ulysses was launched on its way to the Moon by way of Jupiter. And the Astro mission was performed in December with its crew, and, once again, exemplified the advantages of having human beings on board to work around real time problems and to put the human brain in the loop at the front line where it can frequently be of significant value.

Last summer, we spent a very frustrating period where we were not flying with hydrogen leaks. Our safety process does work. We assessed that we had a potential safety problem, decided not to fly until we understood it and fixed it, and, in the meantime, we set off with our engineering analysis to fix it. It was challenging because it was not one problem but it was two independent problems. It confused us for a while until we finally discovered that there were, indeed, two independent problems with similar manifestations. We've repaired both and we're well underway again.

We have the Advanced Solid Rocket Motor now under contract and proceeding forward.

On the Space Shuttle main engines, the alternate turbo pumps are in tests. After a significant period of time in development, we are now in tests, both in West Palm Beach and on our test stands at the Stennis Space Center.

Our Expendable Launch Vehicle activities continue. We launched the Cosmic Background Explorer on a Delta, a Navy satellite on a Scout, a joint German x-ray satellite, ROSAT, on a Delta, and finally the CRRES, the Combined Radiation Release Experiment with the DOD, on an Atlas.

We, just the day before yesterday, announced the selection of our small expendable launch vehicle source of the Orbital Sciences Corporation and their Pegasus vehicle.

As we look ahead, let me tell you what our strategy is. Our strategy is to concentrate on providing assured transportation to and from space; to maintain safety, affordability, and to acknowledge that in the Space Shuttle, in particular, we will be flying more and more complex missions.

As was alluded to earlier, we have in the fiscal year 1992 budget proposed a flight rate that builds up to ten per year. I might add that at this time is driven by budgetary considerations. Our facilities and ability are there to expand it to 12, but that for the time being we will propose a limit of 10.

We will concentrate on major improvements to the Space Shuttle; in particular, enhancements to the main engine, the turbopumps, a new heat exchanger, a two-duct power head. The advanced solid rocket motors are additional improvements.

Mr. CRAMER. Doctor Lenoir, if I could spare you. This testimony is very important but we do have a vote going on and in order for me to make it to this vote, which I want to do, I am going to ask you to pause here. And when the Chairman gets back we will resume. I know all of us have questions that we want to ask and we want to help develop these issues as much as we can. I hope you will forgive us.

So we will be in a brief recess here.

Dr. LENOIR. Certainly.

Mr. CRAMER. Thank you.

[Recess.]

Mr. HALL. All right. Doctor Lenoir, we will ask you to continue your statement. We just barely missed handing the baton off in the hall out there. I think Congressman Cramer went one way and I came another.

Thank you for continuing. We'll go ahead and hear your testimony. Don't be offended by the lack of number of Members of Congress here. Most of the committee is here and it is more important that they hear you. And tell us what you said, and it is for the Members to be here and hear it themselves. So you proceed.

Dr. LENOIR. Okay. I will proceed, although I was corrected that when I described the Ulysses mission I had it looping around Jupiter on its way to the Moon. Unless it is a full Moon, of course, it is supposed to be going to the Sun, and the last time I checked with Len Fisk, the Ulysses was going exactly where it is supposed to. So I will assume it will indeed loop around Jupiter and head toward the Sun.

Mr. HALL. We'll correct the record accordingly.

Dr. LENOIR. The next main major improvement to the Space Shuttle that I wanted to mention was the Extended Duration Orbiter, which is underway in a cooperative commercial agreement with the Rockwell Corporation.

And then finally, but certainly not last, the Assured Shuttle Availability program, whereby we are instituting a formal program to attempt to keep the Space Shuttle flying well into the next century by looking ahead and assessing areas where we are vulnerable to obsolescence or increased operating or maintenance costs and attempting to put a project in place to develop an alternative before it becomes a major problem.

We're putting high priority on developing alternatives to the Space Shuttle. We spoke earlier about a robust transportation system to guarantee we can get into space. We are all uncomfortable, as much as we love the Space Shuttle, we would all like alternatives to the Space Shuttle for getting equipment and people into orbit. Accordingly, with the Department of Defense, we are work-

ing to define a program to develop a new launch system that would for the Space Station and other programs give us an alternative method to get to space other than by the Space Shuttle, and in a people sense, also from the Space Station perspective, an assured crew return vehicle to guarantee that we have a means to get the crew home for those periods of time when we have permanently populated the Space Station and there is no orbiter present.

Our strategy, and you would notice in our fiscal year 1992 budget request, is we have not requested a new Space Shuttle Orbiter. We have deferred from that for the fiscal year 1992 time frame as we go forward attempting to start a new launch vehicle program. We must maintain our institutional health and from the Space Shuttle point of view ensure that we are doing the right things to ensure that we properly support and sync up with the Space Station.

In fiscal years 1991 and 1992, our plans are fairly simple and are well enunciated in our budget. We will fly nine Space Shuttles in fiscal year 1992, four of which will have Spacelabs—that's an International Materials Lab, our Atlas astrophysics mission, the United States Materials Lab, and a Spacelab mission with the Japanese. We will have more expendable launch vehicles than before. We have added the TDRS-G as an expendable launch vehicle deployed mission no longer on the shuttle. The new launch system I have mentioned. We have restructured the Space Station and we will have a hearing in the future to discuss the details of that. In April in Palmdale we will roll out the new orbiter Endeavour and it will be delivered to the Kennedy Space Center in May.

Our first extended down period, our orbiter maintenance down period this summer will occur on Columbia after Columbia's next mission.

And the Assured Shuttle Availability program I mentioned is proposed as an official line in the fiscal year 1992 budget with some new money as well as the alternate pumps from the main engine program transferred over into this.

Looking forward, let me recount our challenges and our concerns. First and foremost is to provide a robust space transportation system. Norman Augustine and his group and his committee focused very much on our single string transportation capability with the Space Shuttle and recommended that we work very hard with the Administration and with the Congress to secure alternatives and to make our national space transportation system more robust. That is a challenge as well as a concern to us.

We will keep safety foremost in our thinking. We must get our flight rate up from what it has been and we're well on our way, develop alternatives, make sure that we combat the growing obsolescence of the Space Shuttles' systems and components, and last but not least, make sure that we contain our costs so that we can afford not only to fly the Space Shuttle but to develop other programs.

Maintaining our corporate knowledge is a continuing challenge. As the Space Shuttle gets older, so do those of us that were around as it was developed.

We need to support our commercial industry. This is an activity that within the Administration has been the source of a new policy. We within NASA are investigating how can we best support

that policy. With our dollars, what is the best way that we can put our focus to assist the United States commercial industry in the fields with which we deal.

Institutional health—our centers, our facilities, our equipment, but most of all our people—remain a challenge to us to keep ourselves up to date and to keep the new blood coming in; so five and ten years from now the leaders of tomorrow will be selected and trained today and tomorrow.

The recommendation of the committee that has overseen us and our own, first and foremost we need adequate and stable funding. We have had programs that have never had the same program from one year to the next because the budget doesn't support it from one year to the next. Adequate and stable funding for all of our programs is vital.

With adequate and stable funding, we can properly change our focus from a near-term focus—what am I going to do to get out of this year—into a longer-term focus—where should we be going in the mid- and late-1990s and how do we get there from here.

We must maintain our ability to produce orbiters. We have opted not to request a new orbiter, but we need to maintain our ability in the future to build another orbiter.

And last but not least, we must make sure that within the Office of Space Flight, and NASA as a whole, we have a proper match of our requirements and the programs that we sign up for and the resources to perform those programs. We in the Office of Space Flight are committed to continuing the U.S. leadership in space and we're doing the planning not only to effect it this year but to sustain it well in the future. And, as I said earlier, in order for us to succeed, we must have and we need your support and your help.

We'd be happy to take any further questions.

[The prepared statement of Dr. Lenoir follows:]

HOLD FOR RELEASE UNTIL PRESENTED BY WITNESS

Statement of

Dr. William B. Lenoir
Associate Administrator
Office of Space Flight
National Aeronautics and Space Administration

before the

Subcommittee on Space
Committee on Science, Space and Technology
United States House of Representatives
March 6, 1991

Mr. Chairman and Members of the Subcommittee:

I am pleased to be here today to present the Office of Space Flight's fiscal year 1992 budget request for the Space Transportation Program. I do so with a sense of accomplishment over the past year's work and resolve to meet our goals for the upcoming year, in spite of the pressure of competing priorities and limited resources.

The fiscal demands placed upon our country now make it more important than ever that NASA use its budget dollars in the most efficient and effective manner possible. Our budget request does just that, by providing the wherewithal to complete the projects we have begun and to prepare for the opportunities of the future.

Working within the constraints of limited resources to meet the goals of the President's National Space Policy, now more than ever it is important that we: 1) lay the groundwork for a stable and appropriate budget plan for the Office of Space Flight this decade, 2) ensure that our Space Transportation Program is responsive to the national space priorities and satisfies our overall objective of assuring access to space using both the Space Shuttle and Expendable Launch Vehicles, and 3) get the maximum return on our investment through good planning and efficient operations.

The Advisory Committee on the Future of the U.S. Space Program, known as the "Augustine Committee," has provided us with a valuable report that serves the U.S. space program in two ways. First, many of its recommendations validate the steps we at NASA were already taking to improve space operations. Second, the report has become a landmark around which the Administration, the

Space Council, the Congress, the space community and the public have rallied. In my statement today I shall touch upon some of the ways in which the Office of Space Flight is implementing the report recommendations that pertain to our responsibilities.

I would like to briefly mention four of these recommendations at the outset. First, Recommendation 6 addresses reconfiguration and rescheduling of Space Station Freedom, with our international partners, to accommodate life sciences experimentation and microgravity research. Our restructure of this program is nearly complete, and our report will be released shortly. I will address issues related to the Space Station in our upcoming hearing on that program.

Augustine Committee Recommendation 9 calls for development of a new unmanned, but man-rateable, heavy-lift launch vehicle. It goes on to say work should begin at once so that the new vehicle can be ready to use for all but the initial work on Space Station Freedom, among other missions. NASA is working with the U.S. Air Force on a plan to develop an evolutionary launch system that will include a heavy-lift configuration. NASA also has completed the Phase B activities for the Shuttle-C concept. Program options for the new launch system will be reported to the National Space Council shortly, for review by the Administration. The Augustine Committee recommends that the highest priority in this area be on the Space Transportation Main Engine (STME) development. This is underway now, and increased funding is requested for fiscal year 1992.

Recommendation 10 advises NASA to defer procurement of a new orbiter but to continue the procurement of spares to keep the existing fleet operational and efficient. The budget request includes $273 million for Orbiter Operational Capability programs. This funding is for orbiter design modifications and system improvements, procurement of a spares inventory for the operational orbiter fleet and necessary safety modifications, a structural spares project to maintain the capability to produce and repair orbiter vehicles, systems integration, and continuation of work started in fiscal year 1988 on an Extended Duration Orbiter capability (EDO).

Last, Recommendation 11 calls for development of a crew recovery capability for Space Station Freedom that is exclusive of the Space Shuttle. The Assured Crew Return Vehicle program moved ahead into the concept definition study stage in 1990, and following completion of the first phase studies and a Systems Requirements Review, the program responsibility was transferred to the Space Station Freedom Project Office in October. Conceptual development contracts were begun to further the studies on the Personnel Launch System (PLS), a two-way module that could eventually augment the Shuttle for transporting crew to and from Space Station Freedom. These contracts supported in-house PLS

feasibility studies. Additional in-house activity included wind tunnel testing, and a full-scale mock-up was constructed for human factor studies.

When the NASA Administrator, Admiral Truly, presented NASA's budget to the full Committee last month, he categorized the Office of Space Flight's functions under the title of Enabling Investments. The programs for which I am responsible make access to space possible -- and assuring safe, reliable, and affordable access to space is my overall goal. I want to stress to the Subcommittee that I am very much aware of the responsibility my office has to the Nation's space program.

FISCAL YEARS 1990 AND 1991 PROGRESS AND ACCOMPLISHMENTS

First, I would like to share with you the accomplishments of fiscal year 1990 and fiscal year 1991 to date. Because the Space Shuttle is the cornerstone of our space activities for this decade, I would like to begin with its accomplishments, followed by a discussion of our activities in expendable launch vehicles and the new launch system development.

There were five Space Shuttle launches in fiscal year 1990.

- During a five-day mission in October 1989 Shuttle mission STS-34 deployed the *Galileo* satellite from the orbiter *Atlantis*. *Galileo* used an Inertial Upper Stage to propel it on a six-year journey to Jupiter, by way of Venus. Galileo has already provided astronomers with valuable information, and its data on the atmosphere, satellites, and magnetosphere of Jupiter is eagerly awaited.

- In November 1989 STS-33 was launched on a five-day, classified mission for the Department of Defense.

- We are especially proud of Shuttle mission STS-32 in January 1990 during which the Long Duration Experimental Facility, the LDEF, was retrieved. The retrieval of this experiment-laden satellite, which had been in orbit since it was deployed by *Challenger* in 1984, once again demonstrated the flexibility and unique attributes of the Space Shuttle. The retrieval of LDEF brought back a wealth of scientific information, including important impact evidence about the micro-debris environment of low-Earth orbit. The crew also deployed a SYNCOM IV-F5 communications satellite for the Navy during this 11-day mission--the longest to date.

- In February 1990, Shuttle mission STS-36 carried out a classified mission for the Department of Defense.

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- **In April 1990, STS-31 successfully deployed the Hubble Space Telescope during a five-day flight. We plan to revisit Hubble in 1993 as part of Space Shuttle mission STS-68. This will improve the space telescope's performance significantly.**

While maintaining a steady and reliable launch rate is our goal, safety is our number one responsibility, not only to our crew but to the taxpayers, given the tremendous expenditure in time and resources each mission represents. For this reason, in the summer of 1990, we grounded the entire Shuttle fleet for five months, in order to find and fix the hydrogen leak problems plaguing *Columbia* and *Atlantis*. In spite of the extended down-time, we are proud to report that immediately following that safety-related operation, we completed three Space Shuttle missions in less than three months.

In October 1990, STS-41 deployed the *Ulysses* spacecraft, built by the European Space Agency, on a mission to study the polar regions of the Sun. It should be noted that this mission was launched within one day of the launch window established a year earlier.

In November 1990, STS-38 carried out a classified Department of Defense mission.

Spacelab returned to flight last year when the *Astro-1* observatory was launched on STS-35 in December 1990. Its four telescopes have already provided valuable ultra-violet and x-ray astronomy data to scientists. This nine-day mission also included a crew-conducted Space Classroom Program, "Assignment: The Stars," to spark student interest in science, mathematics, and technology. We hope to continue such programs in the future.

A number of safety improvements were made to the Space Shuttle fleet and related operations. These included upgrading the liquid hydrogen and liquid oxygen sensors in the external tank, improving orbiter nose-wheel steering and installing carbon brakes, which first flew in April 1990.

Last fiscal year work continued on the new orbiter, *Endeavour*, which will be delivered this Spring.

Last fiscal year we took delivery of a new shuttle carrier aircraft which transports the orbiters from landing site to launch site, and a fourth shuttle training aircraft completed its first flight testing.

In May 1990, we awarded a contract for the design, development, test and evaluation of the Advanced Solid Rocket Motor. We also initiated component-level testing of the new main engine turbopumps at the contractor's pump test stand in Florida in preparation for test firing on the engines in 1991.

Three spare engines were delivered to the Kennedy Space Center; these give us additional flexibility in meeting our goal of a growing, steady flight rate.

And finally, in preparation for the outfitting of the *Endeavour* and the rest of the fleet, drag chute tests were completed in October 1990 aboard a B-52 aircraft.

In addition to our successful Shuttle launches, there were three successful Expendable Launch Vehicle (ELV) launches:

- Cosmic Background Explorer Satellite (COBE) on a Delta in November 1989
- Navy Multiple Access Communications Satellite (MACSAT) on a NASA Scout in May 1990
- NASA/German Cooperative Roentgen Satellite (ROSAT) on a U.S. Air Force-procured Delta in June 1990
- NASA/U.S. Air Force Combined Release and Radiation Effects Satellite (CRRES) on a government-procured commercial Atlas-I in July 1990

Both the *Ulysses* and *Galileo* deployments used Inertial Upper Stage vehicles.

After careful consideration, a decision was made to terminate the Orbital Maneuvering Vehicle (OMV) since no near-term requirement could be identified and program funding in other areas was critical. Negotiation of termination requirements are underway. This decision was reflected in the fiscal year 1991 appropriation.

NASA and the U.S. Air Force jointly sponsored an ELV Symposium with the commercial industry in June 1990. The symposium was held to identify how commercial launch operators may gain access to excess government property and services and how the government plans to exercise technological oversight of launch services procured from the private sector.

Our current new launch vehicle efforts are building on the joint NASA/Department of Defense Advanced Launch Development Program (ALDP). The principal focus of this effort has been the Space Transportation Main Engine (STME); here we selected the gas-generator engine cycle as the preferred option for development and have demonstrated some components under test conditions. We also initiated the construction of the Component Test Facility at the Stennis Space Center. This facility will be used to validate the STME turbopump designs prior to future engine testing.

We continued to study Assured Crew Return Vehicle (ACRV) concepts in 1990, as I stated earlier in discussing the Augustine Committee recommendations. Contractors were selected and we have initiated the study for concept definition for the ACRV. Following

completion of the first phase studies and a Systems Requirements Review, the program responsibility was transferred to the Space Station Freedom Project Office in October in order to ensure a direct linkage between vehicle capabilities and program requirements.

Several developments were introduced at Kennedy Space Center to help reduce the cost and enhance the safety of Shuttle ground operations, including:

- A computer expert system was implemented to assist maintenance personnel in on-the-scene diagnostics, thereby reducing down-time and repair costs.
- An improved flow meter was developed to reduce worker exposure to toxic fluids and costs.

NASA consummated an agreement with the U.S. Space Command in fiscal year 1990 whereby the MIT-Lincoln Laboratory's Haystack Radar would be used to collect orbital debris data. The data collection process began in the latter part of fiscal year 1990 and will continue during fiscal year 1991 to provide valuable data for Space Station Freedom design.

Personnel from NASA visited the space agencies of Europe, the Soviet Union, Japan, and Canada to discuss the problem of orbital debris and to persuade them of the need for united action. The European Space Agency (ESA) and Japan's space officials were very responsive. They have both altered the design of their upper stage rockets to minimize the possibility of explosions. The Soviet Union has not formally stated an orbital debris policy. However, since our discussions in 1990, all deliberate explosions of Soviet satellites have been performed at low altitudes. Other countries are also involved in this issue. A major high-altitude explosion of a Chinese launch vehicle in October of 1990 generated a large amount of long-lived debris. In 1991 we hope to discuss with them the need for minimizing the possibility of on-orbit explosions.

I am personally proud of these accomplishments, but I want you to know that I bring these to your attention on behalf of the thousands of people at headquarters and in field centers across the nation who strive for excellence. As stated in the Augustine report, space projects are "unforgiving of any form of neglect or human failing." The NASA team approaches its work knowing that our national prestige and human lives depend upon it getting done right.

FY 1991 PLANS AND OBJECTIVES

In the Space Shuttle Program, we plan to finish this fiscal year with a total of eight flights. As you know, the Orbiter *Discovery* was rolled back from the launch pad last week in a precautionary safety measure. We are looking into the source of the cracks and plan to launch STS-39 in late April. It will be an unclassified Department of Defense mission for the Air Force and the Strategic Defense Initiative Organization. This eight-day mission, will include the first flight of the new General Purpose Computer system.

Our next Space Shuttle launch will be in early April. The crew of *Atlantis* will deploy the Gamma Ray Observatory as the principal payload of STS-37. During that mission we plan to carry out the first extravehicular activity (EVA) since before the Challenger accident in 1986.

During STS-40, in May, the crew of *Columbia* will conduct several space and life sciences experiments in the first Spacelab Life Sciences mission. Although life sciences experiments have been flown previously, this will be the first Shuttle flight dedicated to this critical scientific discipline. Two months later, a Tracking Data Relay Satellite, TDRS-E will be deployed by *Discovery's* crew during Space Shuttle Mission STS-43. STS-44 will carry a Defense Support Program (DSP) payload aboard *Atlantis* in August.

In support of the Shuttle Program, new engine turbopumps will begin testing at the Stennis Space Center later this month.

In April, *Endeavour* will be presented to the public in a roll-out ceremony in Palmdale. We will actually take delivery in May.

In July we will take advantage of the Triennial Orbiter Maintenance downtime to make major modifications to *Columbia* to extend her capability to 16-day missions. She will also be fitted with safety enhancements, such as a drag chute and improved nose wheel steering. She will return to flight status in mid-1992 carrying the first U.S. Microgravity Laboratory.

By September we plan to have operational the third Orbiter Processing Facility at the Kennedy Space Center, which will be used to support the checkout of OV-105, the *Endeavour*.

In the remainder of fiscal year 1991, three expendable launch vehicle (ELV) launches and one Upper Stage launch are planned. NASA plans to launch two U.S. Air Force payloads, REX in early June, and PROFILE in late June, on NASA Scouts. A National Oceanic and Atmospheric Administration (NOAA) Meteorological Satellite also will be launched by NASA on a on a U.S. Air Force Atlas-E in May. All three missions will be launched from Vandenberg Air Force Base

in California. An Inertial Upper Stage will support launch of the TDRS-E spacecraft aboard the Space Shuttle in June.

In fiscal year 1992, we plan to fly nine shuttle missions, including the first flight of the new orbiter, *Endeavour*. On her maiden flight, Space Shuttle mission STS-49, astronauts will attach a new perigee kick motor to a stranded INTELSAT communications satellite which failed to reach its proper orbit after launch on a Titan rocket. There will be another extravehicular activity in preparation for work on Space Station Freedom.

The Assured Shuttle Availability Program is a life extension program for the Space Shuttle designed to keep it viable well into the next century. We will continue to define this program for implementation in fiscal year 1992.

The Advanced Solid Rocket Motor program preliminary design review will be conducted in 1992. The date of the first flight is currently under review. As you know, the goal of the ASRM project is to enhance shuttle system safety, operability, and performance.

NASA plans to complete a Spacelab improvement study with users during this fiscal year. We will then actively implement the results of the study while preparing and processing flight hardware for three Spacelab module missions and two Spacelab pallet missions to be flown in fiscal year 1992.

The Mixed Fleet Manifest released in February reflects NASA policy, Congressional direction, and the Augustine Committee's recommendations that spacecraft not requiring human interaction be deployed from ELVs rather than from the Space Shuttle. Consistent with this policy, we reassigned the TDRS-G spacecraft to an Intermediate Class ELV. This will result in a competitive selection of a launch service provider later this year.

In the Advanced Development areas, we will continue to emphasize both continued support for on-going programs that will provide greater capability for the future and the promotion and advocacy of new efforts that will complement those programs.

A joint NASA/Department of Defense plan to develop a new launch system will be submitted to the National Space Council shortly, for review by the Administration. Consequently, we are not in a position to discuss program details with you today. However, the objectives that have been set for this program include:

- a range of capabilities, including heavy-lift
- near-term capability that is evolutionary and a longer-term capability that incorporates new technology

- focus on improving operational costs (particularly launch support manpower) and operational resilience compared to existing systems, and
- the potential for a future man-rateable capability for some applications

The resulting vehicles will satisfy the long-term needs of both organizations, will include technologies which will reduce the per-flight costs and increase system operability, and will utilize elements of existing launch vehicles to keep development cost within budget guidelines. In addition, this development effort may provide opportunities to improve U.S. commercial launch capabilities through spin-off benefits to smaller systems.

SPACE FLIGHT FY 1992 BUDGET REQUEST

The primary objective of activity currently underway and planned for fiscal year 1992 in the Space Transportation Systems program is to continue to build up the flight rate while maintaining our strong commitment to safety and mission success. In achieving this objective, we are in consonance with the recommendations of the Augustine Committee by continuing to improve the capabilities of the Space Shuttle while developing appropriate Expendable Launch Vehicles to support a wide variety of national and international users.

The Office of Space Flight's fiscal year 1992 budget request for Space Transportation totals $5534.2 million, including $4654.4 million under the Space Flight, Control and Data Communications (SFC&DC) budget, and $879.8 million for Space Transportation Capability Development, funded under the Research and Development budget. In fiscal year 1991 our corresponding appropriation is $4295.6 million in SFC&DC, and $602.5 million in Capability Development.

The fiscal year 1992 budget request for Space Transportation has as its major focus:

- Increased support of flight requirements, compared to fiscal year 1991, including
  - Nine vs. eight shuttle flights
  - Four vs. two major Spacelab missions
  - Increased Upper Stage requirements
  - Increased ELV requirements
- Initiation of the Assured Shuttle Availability program
- Initiation of the new launch system program, including
  - Development of the Space Transportation Main Engine (STME)
  - Augmented advanced launch studies

Space Transportation Systems Program

Under the Space Flight, Control & Data Communications appropriation, the Space Transportation System is funded under three budget line items: **Shuttle Production and Operational Capability, Shuttle Operations** and **Expendable Launch Vehicles.**

Shuttle Production and Operational Capability

The $1288.9 million requested for Shuttle Production and Operational Capability will provide for capabilities to effectively operate the national fleet of Shuttle orbiters, including the replacement orbiter, OV-105. *Endeavour*, which was fully funded in fiscal year 1987, will be delivered to Kennedy Space Center in May 1991. This budget category also includes ongoing modification and improvement to the fleet and ground facilities necessary to expand Space Shuttle capabilities, increase the flight rate, and expand safety and operation margins.

The budget request of $1288.9 million for the Shuttle Production and Operational Capability category is increased $12.5 million from fiscal year 1991 levels. This total initiates a focused program to assure the long-term availability of the Space Shuttle, offset by completion and phase-down of existing capability development activities. Shuttle production includes $273.8 million for Orbiter Operational Capability, $622.7 million for propulsion systems, $270.1 for launch and mission support, and $122.3 for the Assured Shuttle Availability program.

Orbiter Operational Capability

Orbiter Operational Capability includes $143.3 million for orbiter design modifications and system improvements and mission kits, $13.8 million to complete procurement of a spares inventory for the operational orbiter fleet, $78.3 million for a structural spares project to maintain the capability to produce and repair orbiter vehicles, $19.9 million for systems integration, and $18.5 million for continuation of work started in fiscal year 1988 on an Extended Duration Orbiter capability (EDO), which will increase on-orbit stay time from 7-10 days to 14-16 days. The EDO funding includes initiation of repayment to Rockwell International for the cryogenic pallet, which is being developed as part of a commercialization agreement.

Propulsion Systems

Propulsion Systems provides for continued development effort to increase safety margins and extend the life of Space Shuttle Main Engines (SSME) and Solid Rocket Boosters (SRB). Also included is the development of an Advanced Solid Rocket Motor (ASRM).

The Space Shuttle Main Engines (SSME) experience involving full-up engine systems now exceeds 1700 tests, totalling approximately 460,000 seconds of test and flight time. This experience includes tests, exceeding 84,700 seconds of test operation, at the full power level (FPL) of 109 percent. Since the Challenger accident, we have delayed all activities associated with the operational use of full power. However, single engine testing at these levels has continued to demonstrate margin and safety for the life certification extension test program. In addition, testing is required to demonstrate capability to support extreme abort modes which require operation at full power level.

The SSME budget request is $374.1 million for development activities such as new engines to replace those consumed in testing, ground support equipment, test hardware and support, and improvements to components and manufacturing processes, particularly those that increase safety, reliability, and durability.

Continuation of the SSME technology test bed program, conducted jointly with NASA's Office of Aeronautics, Exploration and Technology (OAET), is included. The technology test bed provides an independent means to evaluate technical advances arising from the SSME development engineering efforts, as well as from the OAET research and technology program. The SSME program funds engineering and support efforts at Marshall Space Flight Center (MSFC) and the Stennis Space Center (SSC) as well as propellants used in engine tests. The SSME program also supports studies and analysis at the Slidell Computer Complex. These efforts provide the technical base for improving the safety, reliability, and durability of the SSME while reducing development and production costs.

The redesign of the Solid Rocket Booster (SRB) to resolve deficiencies in the previous design was completed in fiscal year 1988. Assessment of flight data, including inspection of recovered hardware, will be continuing through fiscal year 1992, with a $48.6 million budget. There is also a continuing activity to improve tooling and procedures to enhance process control and product quality. Reclamation of reusable Solid Rocket Motor hardware contained in solid rocket motors produced prior to the Challenger accident also continues through static firing and refurbishment.

The Advanced Solid Rocket Motor (ASRM) program is intended to enhance the flight safety, reliability and performance of the Space Shuttle fleet. Budgeted at $200.0 million for fiscal year 1992 (excluding facility construction and plant equipment costs in the NASA budget for facilities), the ASRM will employ changes in configuration, design details, and materials to meet more stringent design requirements and enhance safety margins. Production processes will use the latest applicable technology and process automation to enhance reproducability and reliability.

The government-owned ASRM production facility under construction will be a modern, automated production facility which will maximize material and process controls for enhanced reliability. An additional objective of the ASRM is to achieve increased payload capability. The design and development requirements state that there will be no compromise to flight safety and reliability, and that the impact to other Shuttle elements be held to an absolute minimum. An asbestos-free insulation development program is incorporated into the scope of ASRM development. This requirement is driven by environmental and production safety concerns rather than by technical or performance issues.

A significant amount of activity has been underway since the signing of the ASRM prime contract in May 1990. For example, all major subcontracts are under letter agreements; ground clearing is underway at Iuka, Mississippi, in preparation for facility construction planned for the spring of 1991; and design specifications for the construction of facilities and plant equipment are nearing completion.

Launch and Mission Support

The budget request totals $270.1 million is fiscal year 1992, consisting of launch site equipment at Kennedy Space Center (KSC) and mission operations and support capabilities at Johnson Space Center (JSC).

The major operational Space Shuttle facilities at KSC include two Orbiter Processing Facilities, two launch pads, the Vehicle Assembly Building, the Launch Control Center (LCC), and three mobile launch platforms. These facilities and the Orbiter Modification and Refurbishment Facility (OMRF) support processing and checkout of up to three orbiters in flow. The OMRF is being upgraded to a full up Orbiter Processing Facility (OPF) in order to accommodate the delivery of the new orbiter in fiscal year 1991 and the increase in flight rate. Funding is also included to develop new supporting capabilities, such as an automated data management system to control the launch processing flow, and upgraded Checkout, Control, and Monitoring Subsystem (CCMS) of the launch processing system and a Launch Team Training System.

The major mission support at JSC include the Mission Control Center, the flight and ground support training capabilities, the flight design systems, and development and procurement of crew equipment such as the extravehicular mobility units.

Improvements being made include new host computers for the Shuttle Mission Simulator and host computer replacements and console upgrades in the Mission Control Center. Critical improvements in simulation fidelity will be accommodated with the expanded capacity of the new hardware. Increased reliability is

required for the longer integrated simulations; maintenance cost will also be substantially improved with these replacements.

Assured Shuttle Availability

A focused program to assure the long-term availability of the Space Shuttle, the Assured Shuttle Availability (ASA) program, is proposed to start in fiscal year 1992 with a budget request of $122.3 million.

The ASA program ~~will~~ address obsolete systems that are becoming operationally troublesome and increasingly expensive to operate and maintain. Additional benefits include improving safety and reliability and improving the flight turnaround time. In the past these kinds of improvements have been added incrementally when individual items of hardware experienced problems or vendors could no longer supply the older models. It is apparent that these types of requirements will increase as the Shuttle system matures. Procedures in the ASA program will ensure that improvements are evaluated and approved on a priority basis across the entire Shuttle program.

Individual projects will be proposed annually based on a vulnerability assessment across all Shuttle systems. These investments will extend the useful life of the Shuttle system well into the next century. The schedule for development and installation of orbiter-related improvements is designed to take advantage of the planned intervals when orbiters are scheduled to be taken out of service for structural inspections and modifications. This plan provides for an orderly development and implementation program and minimizes interruption of the flight rate capability. Beginning in fiscal year 1992 the funds for continuing the development of the Alternate Turbopump will be included under ASA in order to take advantage of the ASA management approach.

Space Transportation Operations

Space Transportation Operations, with a budget request of $3365.5 million, provides launch services to NASA payloads using a mixed fleet approach of both the Shuttle and Expendable Launch Vehicles (ELV). Launch services are also provided, on a reimbursable basis, to the Department of Defense, other civilian agencies, and certain commercial and international users. The Shuttle program launch schedule is based on eight flights in fiscal year 1991, nine each in fiscal year 1992 and 1993, and a sustained rate of 10 flights per year beginning in 1994.

This sustained rate reflects a reduction from the previous plan of 12 flights per year and is responsive to recommendation of the Advisory Committee on the Future of the U.S. Space Program to limit operational pressures on the Shuttle. The ELV program launch

schedule is based on a mix of launch services in four performance classes, small, medium, intermediate, and large, depending upon the size of the payload each can launch into low-Earth orbit.

In 1989, NASA established a payload Flight Assignment Board (FAB) whereby each civil government primary payload is reviewed for assignment to launch on either the Shuttle or an ELV. The FAB criteria states that a payload will be assigned to an ELV unless: it requires manned presence, it requires the unique capabilities of the Shuttle, or other compelling circumstances exist. The recommendations of the Advisory Committee on the Future of the U.S. Space Program agree with these criteria.

Shuttle Operations

The Space Shuttle has demonstrated a broad range of capabilities including deployment of spacecraft and their upper stages, satellite repairs, satellite retrieval, operations using the remote manipulator, scientific experimentation using Shuttle and Spacelab systems, and extravehicular activity operations. These capabilities provide a unique opportunity to enhance the scientific return of many payloads. Therefore, the Shuttle will remain the largest part of NASA's launch activities for the time being.

The fiscal year 1992 funding for flight operations is $111.0 million above the 1991 levels. This is due to additional manpower and equipment to support an increasing flight rate leading to a sustained capability of 10 flight per year by 1994, normal escalation and the impact of the Department of Defense decision to limit its their Shuttle utilization.

Within the $3023.6 million requested for Shuttle Operations, funding is divided into three areas:

- **Flight Operations** - includes the manpower required, primarily at the Johnson Space Center (JSC), to conduct mission operations
- **Flight Hardware** - includes the necessary flight sets of external tanks, solid rocket motors, solid rocket boosters, and orbiter hardware support elements consistent with the manifest and Shuttle flight rate
- **Launch and Landing Operations** - includes the manpower and recurring activities, primarily at Kennedy Space Center (KSC), to checkout and refurbish the Shuttle, and to conduct Shuttle launches and landings.

The Flight Operations activity, funded at $912.5 million, is divided into three major elements: mission operations, integration, and support.

Mission operations includes training, flight operations activities, and a wide variety of planning activities ranging from operational concepts and techniques development to detailed systems services operational procedures and checklists. We are requesting $318.8 million for this activity.

Integration, budgeted at $342.3 million, includes production and testing of flight software, launch support services and sustaining engineering for orbiter systems, cargo analytical integration, and systems integration.

The Support element includes activity at Johnson Space Center such as aircraft operations, engineering support, and support to the Space Shuttle program office, budgeted at $251.4 million. Shuttle system support for program and integration activities at Headquarters, the Marshall Space Flight Center, Kennedy Space Center, and the Stennis Space Center are also included.

The Flight Hardware program element budgets $1417.0 million for:

- procurement of external tanks (ETs) and solid rocket booster (SRB) elements including motors, booster hardware, and propellants
- orbiter logistics support
- replenishment of spare parts inventory for the orbiter
- SSME component repairs and overhauls
- SSME anomaly resolution activities
- orbiter and crew equipment
- External Tank disconnects
- maintenance and operations of flight crew equipment

Included in the funding request for tanks and boosters are the long lead time raw materials, subassemblies, subsystems and additional ground testing of the Redesigned Solid Rocket Motor (RSRM) needed to sustain and verify the production of elements in a manner consistent with flight rate requirements.

Launch and Landing Operations provides for the liquid propellants and gases plus prelaunch, launch and landing operations of the Shuttle and its cargo. The total $694.1 million requested is divided into $629.3 for Launch Operations and $64.8 for Payload and Launch Support.

Expendable Launch Vehicle Services

The ELV budget request for fiscal year 1992 is $341.9 million, divided into categories based on payload weight to low-Earth orbit:

• Small Class	up to 1,000 pounds	$ 33.7 million
• Medium Class	up to 10,000 pounds	$ 81.5 million
• Intermediate Class	up to 30,000 pounds	$156.5 million
• Large Class	up to 40,000 pounds	$ 70.2 million

This program includes launch services for unmanned civil U.S. government spacecraft that do not require manned presence or the unique capabilities of the Shuttle. Requested funds are for the provision of launch services, launch vehicles, technical management, mission analysis, and associated support services for non-reimbursable government missions launched by NASA. Primary payloads are assigned for launch on ELVs consistent with the Shuttle use criteria established in NASA's fiscal year 1991 Authorization Act. NASA competitively procures launch services from the private sector whenever available, and from the Department of Defense when not available commercially.

The fiscal year 1992 budget request will support launch of the following missions: the Solar, Anomalous, and Magnetospheric Particle Explorer (SAMPEX) in June aboard the last scheduled NASA Scout; the Japanese cooperative Geotail spacecraft on a Delta II in July, the first launch under the Medium ELV launch service contract; and the Mars Observer spacecraft in September aboard a commercial Titan III/Transfer Orbit Stage (TOS).

Funding will also support progress payments and mission analysis activities associated with eleven missions scheduled for launch on ELVs within the next few years. The budget request includes funding to the U.S. Air Force for Titan IV launch services to support the Cassini mission scheduled for launch in fiscal year 1996.

The purchase of a Titan IV launch vehicle for the Comet Rendezvous Asteroid Flyby (CRAF) spacecraft has been deferred for the moment, pending a determination of a revised launch date for that mission.

The payment arrangement whereby NASA procures Titan IVs from the U.S. Air Force has been revised. Previously NASA made payment for hardware in the fiscal year prior to the year of launch. The current payment arrangement requires NASA to provide funding for hardware payments on an earlier schedule. Negotiations are ongoing with the Air Force to finalize the unit prices, terms, and conditions of this new arrangement.

Increased funding of $112.7 million over 1991 levels is due to increased programs payments for the Titan IV for Cassini as well as intermediate vehicles for the SOHO and MSAT missions. The initiation of procurement of an ELV for TDRS-G will be initiated also.

Space Transportation Capability Development

Funded under the Research and Development appropriation, the $879.8 million for this category is shared by eight programs which directly support the science and technology objectives of NASA.

These programs and their funding levels in the fiscal year 1992 budget request are:

• Spacelab	$150.2 million
• Upper Stages	$108.5 million
• Engineering and Technical Base	$235.2 million
• Payload Operations and Support Equipment	$144.5 million
• Advanced Programs	$ 53.8 million
• New Launch System	$175.0 million
• Tethered Satellite System	$ 12.6 million

Spacelab

The Spacelab funding request for fiscal year 1992 is $150.2 million, of which $30.0 million is earmarked for development of this reusable laboratory and payload carrier system, and $120.2 million for operations. This funding level will support four major Shuttle Spacelab missions and a variety of individual experiments or payloads using Spacelab hardware in fiscal year 1992. It will also support preparations for three major missions planned for launch in fiscal year 1993. Spacelab funding, which supports scientific and technology utilization in over 83 percent of the Shuttle flight manifest, will provide the necessary engineering and development activities for flight and ground hardware improvements and/or replacement to assure availability.

Spacelab and the Spacelab carrier systems were developed jointly by NASA and the European Space Agency (ESA). The Spacelab is a major element of the Space Transportation System (STS) that provides a versatile, reusable laboratories which are flown to and from Earth orbit in the orbiter cargo bay. The Spacelab carrier system includes laboratory modules that utilize the full Shuttle cargo capability as well as a variety of smaller payload carriers which provide payload mounting and support services (pointing, computer control, data processing, power, cooling, etc.).

Spacelab hardware preparation and processing for fiscal year 1992 will be initiated to support major Shuttle missions in fiscal year 1993, such as the German Spacelab (D-2) module mission, a second Space Life Sciences module mission, (SLS-2) a second Atmosphere Laboratory for Applications and Science (Atlas II) pallet mission and the Station Radiator/Two Phased Integrated Thermal System (SRAD/TPITS) pallet mission.

In fiscal year 1992 we will also support the integration and processing of seven Hitchhikers and three across-the-bay Get-Away-Special (GAS) bridge carriers which will be flown in fiscal year 1992 and fiscal year 1993.

Increased funding over 1991 levels totalling $20.9 million is primarily for added manpower to support additional Spacelab missions.

Upper Stages Program

The Upper Stages budget request is $108.5 million for the procurement of upper stages for NASA missions and for a solid rocket motor integrity program to improve the technical understanding and the engineering capability for solid motors. Upper stages are required to deploy payloads to orbits and trajectories that are not attainable by the Shuttle or core stage ELVs alone.

The budget request includes funding to support launch of two commercially procured Transfer Orbit Stages (TOS) in 1992. One TOS will support the Advanced Communications Technology Satellite (ACTS) launch aboard the Space Shuttle in the summer of 1991, and the second TOS will support the Mars Observer launch aboard a commercial Titan III in September. Funding will also support purchase of the upper stages for TDRS-F spacecraft to be launched in fiscal year 1993, the TDRS-G, to be launched in fiscal year 1995, and for Cassini, to be launched in fiscal year 1996. Funding of a Centaur stage to support the CRAF mission has been deferred, pending determination of a launch date. The specific Upper Stage and launch vehicle for TDRS-G will be determined based on a competitive selection.

The Solid Propulsion Integrity Program (SPIP) funding request is for continued investigation of materials, design tools, fabrication processes, and controls; examination of product evaluation and verification methods; and improvement of engineering practices, procedures, and communications within the solid propellant community. The SPIP program has made excellent progress in determining the root causes and solutions to persistent problems plaguing motor nozzles and bondlines. The program results are being used across the Nation's solid rocket motor community, including the Redesigned Solid Rocket Motor, the Advanced Solid Rocket Motor, and the Department of Defense solid rocket motor programs.

Funding for Upper Stages is $26.3 million above 1991 amounts due to the continuation of a Centaur Upper Stage for the Cassini mission.

Engineering and Technical Base

The Engineering and Technical Base category, for which we are requesting $235.2 million, provides a core level research and development capability required to sustain engineering, scientific, and technical support. It also funds Safety, Reliability, Maintainability, and Quality Assurance (SRM&QA) support for a wide variety of NASA programs at Office of Space Flight centers (Johnson Space Center (JSC), Kennedy Space Center (KSC), Marshall Space Flight Center (MSFC), and Stennis Space Center (SSC)). Additional

requirements above the core level are funded by the benefitting programs.

The $235.2 million requested is divided into four categories, as follows:

Research and Test Support

This category is budgeted at $148.7 million. It will increase engineering support at JSC and MSFC to support continued operation of a number of engineering and scientific laboratories as well as new facilities in robotics, avionics, and computer aided design. It will also support procurement and operation of advanced computational capabilities required for complex analysis and modeling such as main engine three-dimensional dynamics modeling problems. It will also provide the core of SRM&QA support to a variaty of programs at the manned space flight centers.

Data Systems and Flight Support

This category of activity will continue to provide a core level of support for operation of the central computer complex at Johnson Space Center, among other programs. Its funding request is $23.8 million.

Operations Support

We are requesting $46.7 million for this category to continue to provide for maintenance of multi-program research and development facilities and equipment, chemical cleaning, engineering design, technical analysis, component fabrication, and logistics support.

Launch Systems Support

With a request of $16.0 million, this category is for core capability for engineering, scientific and technical support for research and development activities at Kennedy Space Center. Specifically, the funds provide for multi-program activities, including technical laboratories and facilities and other engineering support services.

Payload Operations and Support Equipment

The $144.5 million requested for the Payload Operations and Support Equipment Category, provides payload services which are required beyond the standard Shuttle services for NASA missions, and to provide multi-mission support equipment in support of all payload operations. A significant portion of the total funding directly supports integration activities for the Space Station Freedom and Space Shuttle, including development of a mating system.

Under this category, $119.4 million is allocated to Payload Operations to support the Space Shuttle integration with Space Station launch elements and a number of other major NASA payloads, including: the Upper Atmosphere Research Satellite (UARS), International Microgravity Laboratory (IML-1), Tethered Satellite System (TSS-1), European Retrievable Carrier (EURECA 1L), Intelsat Reboost, Advanced Communications Technology Satellite (ACTS), Canadian Experiment (CANEX-2), Diffuse X-ray Spectrometer (DXS), Atmospheric Laboratory for Applications and Science (ATLAS-1), and United States Microgravity Lab (USML-1). The Payload Support Equipment allocation, totalling $25.1 million, will include communication equipment to accommodate required payload data transmission, among other programs.

Growth of $43 million over 1991 is driven by the start of Space Station integration activities and additional NASA payload processing.

Advanced Programs

The Advanced Program Development budget request for fiscal year 1992 is $53.8 million, and will emphasize concept definition, system definition, and advanced development. This amount is divided into Advanced Transportation ($26.6 million), Advanced Operations ($12.5 million), and Advanced Space Systems ($14.7 million).

Funding for studies and technology efforts in the Advanced Transportation area is being increased to reflect an increased priority on activities related to advanced launch systems, such as the two-way personnel transportation system, and the automated rendezvous and docking capability for unmanned vehicles.

The continuing goals of the Advanced Operations Program, for which we are requesting $12.5 million, are to improve ground and mission operations efficiency, safety, and cost effectiveness for the Space Shuttle Program through the introduction of advanced technologies into the operations environment.

The Advanced Space Systems program encompasses the following areas: flight demonstrations, orbital debris, on-orbit servicing, and transportation-related tether applications. Fiscal year 1992 funding is at $14.7 million.

New Launch System

Consistent with joint NASA/Department of Defense planning to develop a new launch capability, the fiscal year 1992 program is expected to include the initiation of the STME development program (with focus on engine prototype activities), the continuation of vehicle technology efforts, and a Phase B vehicle study effort. The vehicle Phase B effort will address the technical issues of a

common liquid core which could be used in both a 50,000 - 80,000-pound vehicle and a related 150,000-pound heavy-lift configuration. The NASA funding requested for fiscal year 1992 is $175.0 million, with the Department of Defense to provide an equal amount.

Tethered Satellite System

The tethered satellite system (TSS) is a cooperative U.S./Italian development vehicle which is scheduled in February 1992. The final integration and launch preparation for this mission as well as post-flight data reduction, hardware disassembly and system update will require a funding level of $12.6 million in fiscal year 1992.

This mission will demonstrate the capabilities of the system and conduct electrodynamic investigations. The TSS will be deployed to a distance of 20 KM (12 miles) above the Orbiter on a conductive tether.

Orbital Maneuvering Vehicle

Following the termination of the OMV, NASA subsequently canceled plans for the Satellite Servicer System Flight Demonstration. Our on-orbit servicing program has been redirected at developing servicing tools and techniques in support of ongoing NASA space programs for which the Office of Space Flight has a servicing commitment.

Other Areas of NASA's Budget

The NASA budget also includes several projects in the Construction of Facilities (CoF) request which are critical to the Space Transportation Program. Included is funding to allow for the completion of the addition for flight crew training and operation facility at Johnson Space Center. We are also requesting funding to modify the Vehicle Assembly Building at Kennedy Space Center to provide a "safe haven" to allow the return of a fully stacked mobile launcher from the launch pad in the event of a hurricane which could cause severe damage to the Shuttle. Restoration of existing major facilities include the Kennedy Shuttle landing facility shoulders and certain designated sections of the crawlerway between the Vehicle Assembly Building and Launch Pads and A and B. Also included is rehabilitation to the high pressure gas facility that supports the Space Shuttle Main Engine test program at Stennis Space Center.

In addition, the portion of the Research and Program Management (R&PM) budget managed by the Office of Space Flight is $1034.0 million and supports 10,083 civil service positions in the fiscal year 1992 budget request. The civil service personnel, travel and operation of installations are essential to ensure that the Office of Space Flight R&D programs are managed effectively.

Although the workforce level is the same as in fiscal year 1991, the personnel budget has to include the President's recently announced 4.1 percent pay raise, along with associated benefits. Most of the increases in the other R&PM areas reflect economic escalation and are necessary to maintain the existing level of operations to support the programs at the Office of Space Flight Centers.

KEY CHALLENGES

I would like to bring this statement to a close by sharing with you my vision of the principal challenges we face in the space flight program in the coming years. Although the challenges are many, we can categorize them principally under safety, reliability, and efficiency.

In meeting our goal of assuring robust space transportation, my number one concern is preservation and improvement of safety margins in program hardware, systems, and operations . I want to assure the Subcommittee that all of our systems are being improved to ensure that safety margins are adequate in all conditions. In some cases, such as the Advanced Solid Rocket Motor program, entire program elements are being redesigned with higher safety margins and system longevity in mind. We are working with the Department of Defense to enhance our launch capability with provision of a new launch system to complement the Space Shuttle's capability.

Achievement of a reasonable and steady flight rate is another of my top objectives and a considerable challenge. As I stated previously, our goal is a steady ten Shuttle flights per year with expendable vehicle missions augmenting that number. To this end, an effort is underway to reduce processing time by comparing existing maintenance requirements and processing procedures to flight experience. The most efficient way to manage program logistics also is being studied.

Since the reliability of any complex system is affected by time and wear, orbiter obsolescence is being addressed by a modernization and maintenance program that will also extend the life of the Shuttle program. It is also important to maintain some level of orbiter production capability to ensure the availability of spare parts, as well as to ensure that another orbiter could be built in the future, if necessary. Our Shuttle production capability effort includes the structural spares program through which major components and spare parts are regularly purchased.

Another one of the challenges I see is achieving a reduction in operating costs by increasing productivity and efficiency. Some of this will happen through efforts to simplify processing as part of the effort to achieve 10 flights per year. In addition, changes to Shuttle flight elements are being minimized to those

that promote safety, efficiency, or longevity. Support manpower is being reduced where practicable. And automation is being used where possible to cut processing time and costs.

Maintaining corporate knowledge is a tremendous challenge. We face the loss of 30 percent of our managers, primarily through retirement, in the next three years. We face the challenge of a decreasing pool of qualified candidates for some of our most important positions impacting safety and mission success. NASA has an agency-wide effort underway to provide our employees with the opportunity to keep their educations current, and to move up the career ladder.

The members of the Augustine Committee and the chairman of this full committee have said that one key NASA need is consistent and stable funding. We are supporting many activities, including some new ones, in a difficult funding environment. Stability of funding plans is especially important when new programs are begun. Instability results in redesign (and its associated costs), decreased capability, longer development schedules, and inefficient use of funds. Consistent funding will ensure that we are not penny-wise and pound-foolish, and that we get the most for our investments.

Agreeing with the Augustine Committee that we have to establish our goals before we form our specific program objectives, we are developing a long-range plan for the Office of Space Flight. It will help us to support NASA's overall mission well into the next century. This plan will go a long way toward breaking out of the short-range focus that sometimes seems to reach only as far as the next mission, and not to be bigger picture of the future.

We believe that a strong, competitive American space industry benefits the country. Technology development is a vital NASA function, and one of our objectives is to help enhance the U.S. aerospace industry by transferring the technology we develop. One of our challenges, then, in pushing the state of the art in areas such as rocket engines is to ensure that NASA-developed technology is made available to the private sector on a timely basis. This is particularly important in light of the challenges from abroad now faced by U.S. industry.

It is also important that our institutional resources be adequately supported. New program requirements, in the early phases, are accommodated by using existing institutional resources. But in the face of program funding restrictions, it is all too easy to neglect the physical plant. The NASA Office of Space Flight institution is an irreplaceable resource for space flight development and operations. The replacement cost is estimated to be $8 billion. It is essential to maintain these facilities and equipment.

SUMMARY

The foundation of all U.S. space activities is space transportation. Without adequate transportation, no scientific or exploration activities would be possible. We are committed to enhancing the reliability, operability, and schedule predictability of the Space Shuttle; to increasing our use of expendable launch vehicles; and to developing a new launch system.

Understanding the difficult fiscal situation forcing keen competition for budget dollars, this budget reflects austerity and efficiency while maintaining productivity. We have underway a reexamination of the role of the NASA centers across the country. We are simplifying processing requirements and implementation, and reducing operations manpower.

Throughout the budget process and the goal-setting activity that it requires, we have taken into consideration the recommendations of the Advisory Committee on the Future of the U.S. Space Program. We have taken steps to implement many of the recommendations already, and our budget request for fiscal year 1992 continues the process.

Our space flight programs represent an investment in the future. The programs' goals are achievable if the required commitments of resources and national will is made. The President has stated that our will to explore the unknown frontier of space, both with robotic probes and manned missions, is one measure of the vision and maturity of the Nation. We are convinced that there is such a national will.

Further, the United States' space flight programs will help to advance knowledge in many scientific fields, that will provide man with the means to achieve the greatest adventure of all -- interplanetary space travel -- and will help us solve global environmental problems here on earth. Mr. Chairman, nothing moves the imagination and inspires the dreams of our children in quite the same way as space exploration. The successes of our programs affect the way our children -- the leaders of tomorrow -- view themselves, their planet, their place in the galaxy. We have a responsibility to them to do the very best job we can.

Mr. Chairman, President Kennedy once said that "we dare to do things not because they are easy, but because they are difficult." We have many challenges ahead of us in these difficult times. We are looking forward to meeting them by building upon the solid base we have already established.

We look forward to working with the Subcommittee toward expedient approval of this budget request. I will be pleased to respond to any questions you may have.

New Launch System

Mr. Hall. Doctor Lenoir, thank you very much. I am sure there will be some questions.

I cannot help but take advantage of getting to ask questions of the guy who is head of the Space Flight, the one, I'm told, of the most powerful and resourceful witnesses we'll have. So let me ask you some questions.

Let's talk a little about the new launch system. This, as I understand, is being pushed by the Administration—it's an Administration request. I won't ask you to comment on Admiral Truly's attitude toward it, if you knew that attitude; but I presume you and the Admiral and others are adhering to duty to try to carry out an Executive wish and that they are going to have an awful lot to say about the future and the present, as they have had to say about the past. So we want to work with them and you on that.

I think it is hard for me to see a real sincere push for the launch vehicle that's not delivered until 1999, is that correct?

Dr. Lenoir. That's our current working date, yes, sir.

Mr. Hall. And as I understand it, the Space Station begins in November of 1995 with hopes of finishing it by September 1999.

Dr. Lenoir. For the initial configuration, yes, sir.

Mr. Hall. And the Moon-Mars program is off around 2010, 2009, or sometime.

Dr. Lenoir. I'm not sure what the date on that is.

Mr. Hall. But it's on down in the future considerably.

Dr. Lenoir. It starts with a "2."

Mr. Hall. I guess the question that I want to ask you, and I'm sure you have the answer, is if the launch vehicle is not going to be available till September of 1999, it appears that it will be too late to help us with the Space Station. Justify for me, if you will, why we would go ahead and do it at this time when we're too early for Moon-Mars and it is a vehicle that would be probably very much needed for both of those operations. I think, you know, just discuss the new launch system for us, if you would, with those questions that I suggested in mind. Then I have some more.

Dr. Lenoir. Okay. Thank you, sir.

Mr. Hall. And we have the five minute rule and I understand from Mr. Dawson here that it is a five minute rule, he really sets it for six minutes, but we'll go for five. We had an abstractor in my home town one time that was a one office guy and he would always leave a sign when he'd go to get coffee that said "Be back in five minutes; been gone three." You take advantage of that. I have five minutes to ask you questions—it's really six.

Dr. Lenoir. Okay. Does that count my answer time, too?

Mr. Hall. Well, I'm going to try to cheat a little on the guys to the right and left of me here on using some of their time.

Dr. Lenoir. Okay. The new launch system has gotten increased attention this year I think largely because of the very, very strong recommendation from the Augustine Committee, and when Admiral Truly hears me say that on TV, he's going to berate me when I get home because I'm supposed to use the official name of the Committee but I forget it because it is about eight words.

Mr. Hall. All right.

Dr. LENOIR. But it is Norm Augustine's committee. They came out very strongly saying that while the Space Shuttle was a good system, and they did not recommend that we phase it out, but they were uncomfortable with our total reliance on the Space Shuttle, as frankly are we within NASA. They recommended very strongly that we move a new vehicle to the head of the line in a priority sense. That ahead of buying a new orbiter we place some of our 1990s robustness at risk in order to do the right thing today for robustness after the turn of the century. We studied that and we concurred.

We have come forward and we are working with the Department of Defense on a new launch vehicle that, if we succeed, will serve both of our needs. The needs that we said that NASA had was to support all but the initial phases of the Space Station development, which we interpret is up to about 1999, largely because we can't get a new vehicle much before then anyway, and then the ability to grow beyond that and to evolve into larger and larger vehicles to support exploration as we understood what the exploration requirements were.

In parallel with that, we have restructured the Space Station. We are currently discussing within the Administration a two-phased initial part and then an open-ended follow-on part, where the initial part has what we call a man-tended—a laboratory in space that can be visited by a Shuttle, and as we visit it and use it, we also continue to assemble it and approximately in the year 1999, perhaps 2000, we would achieve the permanently manned capability with a habitation module.

Our current planning enables us to do all of that from the Space Shuttle since, after all, this was designed to be deployed by the Space Shuttle.

We have studied, as was asked earlier, artificially delaying the Space Station in order to be in sync with another launch vehicle. That doesn't add any value to the Space Station program and will essentially cause our international partners to take a walk because they cannot stretch out that long and we would be unable to launch them.

The Space Station is required to be robust enough that at any point in its design, should I not visit it with a Space Shuttle for years, it will survive and still be ready say two years later, potentially even three years. We see no risk in continuing to develop the Space Station and assemble it in the unlikely event that we had a problem with the Shuttle that stood us down for a while, the Space Station could continue to survive until after the Space Shuttle were operational and we continued or the new launch vehicle came on line.

As we look past 1999 and postulate the existence of a new launch vehicle with higher performance capabilities, I can now contemplate higher power levels, larger crews, additional systems, additional laboratories, and whatever my first decade of operation on a Space Station teaches me I want. I can contemplate building that around the capability of a new heavier lift launch system, which ties in very well with that timing. So we see it as being a very natural progression and that the Space Station, the Space Shuttle, and

a new launch system are all mutually supportive and consistent with each other.

SHUTTLE C AND SATURN V

Mr. HALL. I'll be a warm up for Congressman Nagle for when he gets here I suppose in asking the questions that I'm about to ask. But Shuttle C or Saturn V could be available for the Space Station, yes or no?

Dr. LENOIR. We think the Shuttle C might be available two years before the 1999 time frame depending on funding. The Saturn V we don't think we can build any sooner than 1999, and, frankly, it would cost about as much.

Mr. HALL. Well, I was under the impression that it cost about $4 billion for Shuttle C.

Dr. LENOIR. That's correct; about $4 billion for Shuttle C.

Mr. HALL. And that the heavy lift vehicle was closer to $12 billion.

Dr. LENOIR. Our current thinking is in the $10 to $12 billion range.

Mr. HALL. And if Saturn V carries about 240,000 pounds and the heavy lift carries 160,000 pounds, as does Shuttle C, tell me again about the advantages of the heavy lift. It costs more and carries less. I know there are some advantages and I would like to have them for the record.

Dr. LENOIR. Okay. The Saturn V, incidentally, we haven't finished looking at, but we've taken a quick look. The drawings do exist but virtually none of the manufacturing facilities, none of the tooling, and many of the vendors are no longer in that business. In order to rebuild it, even given the drawings, recertify the processes, and requalify the hardware would take about as long as the new launch system and cost almost as much—in the $10 billion range. The facilities, for example, at the Kennedy Space Center that were used to launch the Saturn V no longer support the Saturn V, so we would have to build new facilities. We see no particular advantage to the Saturn V, as well as it being technology that is decades old.

The Shuttle C is cheaper and can be brought on line sooner. It suffers from some disadvantages. The disadvantages are that it doesn't provide me as much independence of the Shuttle as a new launch system; in that if I had a problem with a main engine, or a tank, or a solid, it would take both of those systems down.

Mr. HALL. And won't your heavy lift be cheaper to fly?

Dr. LENOIR. Yes. The heavy lift is going to be cheaper to fly than the Shuttle C as well as providing me with new technology. The United States has not built a new large engine in over two decades. So we will have a new engine and clean burning engine.

Mr. HALL. If I can get back to it, I'll ask you about the fact that it has more uses, and let you get that into the record. But I think my time has probably expired.

I recognize the gentleman from Texas, Mr.—he's not here.

The gentleman from Arizona, Mr. Rhodes.

We'll try Mr. Henry. Congressman Henry.

FUNDING FOR NEW ORBITER

Mr. HENRY. Well, thank you, Mr. Chairman.

I have to say, as someone who has tried to untangled this and has been an on- and off-again member of this subcommittee, every time I come back we have a new National Space Plan. That's why I kind of chuckle when I hear statements saying that if we had adequate and stable funding we might have an adequate and stable space program. One of the reasons we don't have adequate and stable funding is that we don't have an adequate, stable space program. I mean, which comes first, the chicken or the egg. We'll get into the Space Station I guess at our next hearing, Mr. Chairman.

But in relation with that, let me ask some questions relative then to the orbiter, which we're apparently going to be using. Do we need another orbiter? There is no budget request money for the orbiter. Did you request of OMB money for a new orbiter?

Dr. LENOIR. Our initial request to OMB did have a new orbiter in it. I'll be honest, I forget whether they took it out or we did, but either way, OMB and the NASA concurred in the light of the Augustine Committee recommendations in the December time frame to remove it from the request and in its place to put money for a new launch system.

Mr. RHODES. So basically a year ago NASA felt it needed a new orbiter. Now, with the reconfigured Space Station, you don't need a new orbiter even though we increasingly have problems with the orbiter. That's basically what's happened in a year.

Dr. LENOIR. We still feel that we would like a new orbiter. Our justification for needing one, in a vocabulary sense, was based on looking ahead. We will take delivery of Endeavour, which will give us a four orbiter fleet, and I have to postulate that over the next decade I'm going to have some systems failures, I'm going to have some problems, and the likelihood is that one orbiter will in one way or another be out of service. And in order to support 12 flights a year, which is also what our budget that went to OMB was, I need four orbiters. So we justified a fifth orbiter by saying in order to guarantee four, I need five.

When we decreased with OMB the flight rate from 12 to 10, I can get more comfortable that 4 orbiters will last me longer. If my arm is twisted, of course we would like another orbiter. But as I said earlier, it is a matter of priorities. There is only so much money to go around. And we concur that a new launch system ought at this time have a higher priority, and we ranked it accordingly.

Mr. HALL. Will the gentleman yield?

Mr. RHODES. I'd be pleased to yield.

Mr. HALL. Do I understand that we now have three orbiters plus the replacement for Challenger's?

Dr. LENOIR. We have three orbiters today and a fourth one coming on line in a few months.

Mr. HALL. Soon. And what you're saying is NASA wants one more.

Dr. LENOIR. In order to support 12 flights a year, we need to be operating 4 at a time, and that indicates we really need 5 orbiters to support that flight rate over the long haul.

Mr. HALL. I was under the impression you'd leveled that off at 10 flights per year.

Dr. LENOIR. We have. That's what I say, in the budget that we submitted to OMB it was 12 flights a year. The one that we have negotiated with OMB and sent to you is for 10.

Mr. HALL. So you have three, one almost ready, and you need a fifth, and you're suggesting a sixth.

Dr. LENOIR. The four orbiters is sufficient to support ten flights a year essentially indefinitely as long as we don't lose the services of one of those four orbiters.

Mr. HALL. Okay. You have three, you're going to get another one, and you're suggesting a fifth then. Is that better for the record?

Dr. LENOIR. We would like a fifth but we're not requesting one at this time.

Mr. HALL. Thank you. I yield back.

Mr. RHODES. I'd just relate to that, with the current rate of funding of structural spares, are we maintaining an option for that new orbiter if it is decided it is necessary?

Dr. LENOIR. Yes, we have an activity underway and I have asked Bob Crippen to study the question of what does it take for us to maintain the ability to produce orbiters, and to report back to me monthly. One of the things that we have done is to allow the Structural Spares Program to not be accelerated but to stay at the initial schedule that we had started in order to use that to maintain a support for certain key skills and people for a longer period of time.

PROBLEMS WITH SHUTTLE FUEL ACCESS DOORS

Mr. RHODES. In regard to the cracks in the fuel access doors of Discovery, we're being told that they may have been caused by excessive opening and closing of the doors. I understand the doors are to be cycled only 6 to 8 times between missions, but we've learned that they are actually cycled up to 80 times between missions. Is that a correct assessment in terms of what the design capacity was and what the use has been?

Dr. LENOIR. The design was envisioned maybe six or eight times. I wouldn't say that it was limited to that capacity. We have discovered that we are cycling these doors far more often than we realized and we have to look at that. We didn't take the best time to look because we made a modification to the door in order to check rigging and everything. You expect to cycle them more than normal.

We don't believe that the Discovery doors were broken due to excessive cycles. We believe they were broken due to procedural errors. We do have a situation on this lug that is susceptible to what we call fatigue. Very small cracks will form under this fatigue. What has happened after a small crack has formed—which we consider a flyable condition, not a major problem—is an event happened that overloaded it and broke it, just tore it apart. Even so, that condition is flyable and our engineering analysis is unanimous that says that will support everything that happens in flight and there is no safety issue.

We were uncomfortable though, we couldn't identify exactly what that event was that broke it so we could guarantee that won't happen in flight; although we think we know what those two events were in the two cases. One was with the door latched open, the other door unlatched, and intending to send a command to close this door, we sent a command to the wrong door. Told this one to close, we held it open and overloaded it and broke the lug. At some earlier time on the other door, we closed it with a screw caught in it that prohibited it from closing all the way. We believe that also stopped it, allowed the motor to overload. But we can't 100 percent prove it, so we decided to be safe and roll back. The fatigue cracks are not a major issue in their right, although we will over the next year put in a design change to fix those so that those don't happen.

Mr. RHODES. But fundamentally it is not a structural problem in your judgment, it's an operational problem.

Dr. LENOIR. That is true.

Mr. RHODES. Thank you very much, Mr. Chairman.

Mr. HALL. And you made the decision to roll back. You made that decision, didn't you?

Dr. LENOIR. Yes, sir, I did.

Mr. HALL. And it wasn't any big deal really?

Dr. LENOIR. I didn't think so.

Mr. HALL. The Chair recognizes Chairman Cramer.

ASRM PROGRAM

Mr. CRAMER. Thank you, Mr. Chairman. And I made my vote, so I appreciate that.

Doctor Lenoir, as I said earlier, I am a product of the space program in a sense in that I grew up there in Huntsville, Alabama, watching the space program and watching the community grow around the space program there.

I want to ask you a couple of questions particularly about the ASRM program. When Admiral Truly was here, as well as J.R. Thompson, I had noticed the line item in the budget that that project was down in the R&D side almost $100 million. Would you characterize the Yellow Creek project? Is that a viable project, in your opinion?

Dr. LENOIR. Very much. The Advanced Solid Rocket Motor is a viable program; it has made great strides this year and is moving forward. As we went through our budget deliberations and tried to find enough money to support everything, including a fifth orbiter, we found there just wasn't enough money there. We put our priorities together and, as I said, we decided that we would for 1992 not ask for a new orbiter. We cut the Advanced Solid Rocket Motor somewhat in order to make everything fit.

We are in the process now of reviewing the program and putting back together a complete end-to-end story that fits end-to-end. And with the monies requested in 1992, to look at what does that mean for 1993, 1994, 1995. What implications, if any, does that have on the first flight date, and we think it does; and guaranteeing that whatever we do there is also consistent with the Space Stations desires to depend on the Advanced Solid Rocket Motor for its sixth

assembly flight where we will be launching the lab module. And that activity is going on today. We anticipate it will take another month, month-and-a-half in order to bring that to closure within our budget cycle that we go through in getting ready for the 1993 budget.

Mr. CRAMER. Would you expect a lot more of these to be required?

Dr. LENOIR. That's one of the questions we're trying to answer. I can't give you a definitive answer, but something on the order of 150 more is almost certainly sufficient and perhaps somewhat less. We will have that answer in the middle of April.

NEW LAUNCH SYSTEM

Mr. CRAMER. I want to come back then to the new launch system. That is a joint NASA/DOD program.

Dr. LENOIR. Today it is nothing but a gleam in both of our eyes. We are proposing that it be a joint NASA joint DOD program.

Mr. CRAMER. And who would manage the program?

Dr. LENOIR. We would put together an entity that would be joint NASA joint DOD, with half our people, half their people, half our money, half their money, and we would manage it together in a joint program office.

Mr. CRAMER. Thank you very much. Thank you, Mr. Chairman.

Mr. CRIPPEN. Thank you, Mr. Cramer.

In the order that they reached the subcommittee hearing, I think Mr. Bacchus is to be recognized next.

Mr. BACCHUS. Thank you, Mr. Chairman.

Doctor Lenoir, I would like to follow up on questions asked by the Chairman and Mr. Cramer. First of all, on the NASA/DOD cooperation on the new launch vehicle, what do you see as the advantages and the disadvantages of such a joint venture? What are your different perspectives given your bureaucratic turf?

Dr. LENOIR. The advantages aren't apparent at first blush. We have to test and make sure that they are real. If the premise that the same vehicle properly chosen can meet both our requirements and theirs, and we can jointly fund it, then that will cost half as much to NASA.

Mr. BACCHUS. So there's considerable cost-savings potentially?

Dr. LENOIR. Yes. That's one advantage. Another advantage is that both NASA and the DOD have considerable expertise in the launch vehicle world and each of us would benefit from the other's expertise. So that the expertise within the DOD, we would be able to make better use of than if we went off and built a NASA only program. Similarly, our propulsion expertise that's leading the way in a new hydrogen/oxygen engine also is available to the DOD in a joint program.

Mr. BACCHUS. Do the two entities have different inclinations? Are you, for example, for more inclined to support some use of Shuttle technology or a derivative thereof; are they more likely to support some entirely new type of vehicle?

Dr. LENOIR. I would say it started that way but as we sat down and arm wrestled and tried to put it on paper to make it a convincing case on paper, we both migrated in toward the middle in the

same conclusion. And as we get ready to come forward to the Space Council, we don't have any major disagreements on what the vehicle ought to look like, what degree of technology ought to be in it, how much of it should be derived from Shuttle—which, incidentally, is considerable—and where we ought to concentrate our new technology activities. We're pretty much unanimous.

Consolidation of Shuttle Operations

Mr. Bacchus. A second unrelated question. The Augustine Committee recommended, among many other things, the consolidation of Shuttle activities at the Kennedy Space Center. Do you agree with that recommendation? If so, what progress are you making to implement it?

Dr. Lenoir. We agree with the intent of that recommendation. I say intent, not trying to skirt out from under this, but I've read all kinds of things like we're going to shut the Johnson Space Center down and move it to the Cape, Huntsville is going to move to the Cape; and none of that is what's in mind here.

We have a Space Shuttle that is being operated. We shy from calling it operational in that it will never be operational as an airliner is operational.

Mr. Bacchus. But it is no longer developmental.

Dr. Lenoir. It is no longer developmental but it does have requirements every day. We're undergoing today with our lugs and our cracks that the operators must be in daily contact with the developmental engineers in order to assess that we have a condition that we're happy with and we're comfortable to go fly. Nonetheless, we are very strong in our support of our recommendation that says we can, should, and we will do more to make it more operational and to look at those activities which can be transferred wherever they belong, but primarily focusing on moving toward the Kennedy Space Center.

And, accordingly, I have tasked Captain Crippen, as the Director of the program, to put together a list of all of the things that the Space Shuttle does today and to identify those that are candidates to be relocated to the Kennedy Space Center, to develop a set of criteria against which I can judge each one and decide when and where and whether, and then to look at that and begin to make those transitions as we put the program plan together. It will take us basically a year to bring that plan to completion because we want to be very careful that we do nothing that will adversely affect our safety.

New Orbiter

Mr. Bacchus. One final question, following up on one of the Chairman's questions. We have the Discovery, Columbia, Atlantis, we're bring the Endeavour on board. We've been talking about the possibilities of a fifth Shuttle, I know you haven't requested it. We've also talked about the fact that the Space Station apparently will be in place before we have the new heavy lift capability. If we did decide we wanted a fifth Shuttle, how long would it take to produce one?

Dr. LENOIR. Oh, a fifth Shuttle is from the configuration we're in today is about four years from a serious start. Frequently we start with just a few dollars to get the idea going. A few dollars wouldn't help us get started; that would take five years. But a serious start could be done in about four years.

Mr. BACCHUS. So it might or might not be available then to help with the Space Station assembly?

Dr. LENOIR. It would depend if we started four years ahead of when we need it.

Mr. BACCHUS. Once the Endeavour is on board and available, are you content that our Shuttle fleet would be sufficient to assemble the Space Station as reconfigured?

Dr. LENOIR. With the Endeavour on board and no accidents or incidents that cost us the use of a Shuttle, yes, the four orbiters is sufficient to completely assemble the Space Station and continue to operate it.

Mr. BACCHUS. Thank you, Doctor, and I would appreciate your office keeping me informed on your progress on the consolidation at the Kennedy Space Center of the Shuttle activities.

Dr. LENOIR. Okay.

Mr. BACCHUS. Thank you, Mr. Chairman.

Mr. HALL. Mr. Bacchus is our resident astronaut to Kennedy and a very key guy on this committee.

Mr. BACCHUS. I want you to know, Mr. Chairman, my wife has told me I could come to Washington but I cannot go into orbit.

Mr. HALL. All right. You'd be alone up here if you don't. [Laughter.]

We'll recognize Mr. Perkins from Kentucky.

HEAVY LIFT LAUNCH VEHICLE

Mr. PERKINS. Thank you, Mr. Chairman.

Gentlemen, I wonder—I certainly would first of all agree and congratulate you on the concept that we need a heavy lift launch vehicle. There is no question in the number of years that I've served on this subcommittee the need for an expendable launch vehicle of some sort, and particularly one that has the capability of going and moving heavy quantities, is something that we've desperately needed in the past.

I wonder when you talk about just being a gleam in your eye and the Department of Defense's eye, that didn't it sound like you have some fairly specific things that you are going to be putting into this. You have 160,000 pound capability, I think you indicated; you have some idea of what technology you want to develop; what Shuttle technology would be utilized. What can you tell us at this stage, and I realize it is very preliminary, of the specifics of what this thing's capabilities are going to be other than what you've told us so far?

Dr. LENOIR. Okay. Let me backtrack for just a minute and retrace the steps through the comment that used the word "gleam." Otherwise, I am going to be chagrined, I think, reading tomorrow morning's papers.

What I meant by it is a gleam in our eyes is not that we don't support it, but that it is not yet an approved program. The Admin-

istration has not yet firmly approved it as a program to send up to the Congress, nor has the Congress agreed. We do believe that we have with the DOD converged on what is the right approach. We are continuing to make sure that the Administration is comfortable with that, just the DOD and the NASA are.

But from a NASA perspective, specifically, we would ask in the late 1990s—1999, 2000—to have performance capabilities like Shuttle; be able to take at least 50,000 pounds to low Earth orbit, launching due east out of the Cape, and to have the ability to grow gracefully, quickly to in the 120,000 to 150,000 pounds in order to support what we know of as the beginning of our exploration requirements.

Mr. PERKINS. So you are talking about a stage type of thing? Initially starting up with just the 50,000 pound capability, and then growing to 120,000 to 150,000 pound capability?

Dr. LENOIR. That was how we started. Where we are right now, however, is to take those two events and collapse them to one. We find out that the former stage, what we have initially called 50,000-80,000 pounds, but it is in that 50,000 pound range, doesn't take much more to hang two Advanced Solid Rocket Motors on it and now I have a vehicle that's in the 120,000 to 150,000 pound range, and for virtually no extra time and not a lot of extra money that supports in about the same time frame.

Mr. PERKINS. What are you talking about in terms of a cost estimate for something that would go in the 120,000 to 150,000 range?

Dr. LENOIR. We're continuing to make sure that we get independent assessment, verify that our estimates are correct, but currently our internal working numbers are in the $10 to $12 billion development range.

Mr. PERKINS. I understand that. I am talking about once you've developed the thing, in terms of the individual launch itself, how much per launch would that cost?

Dr. LENOIR. That's highly a function of flight rate, which I don't think we have a very good handle on right now, but that runs from numbers that are somewhat under $200 million, even as low as $100 million, up to $500 million if I talk something like a Shuttle C. But the lower numbers are the ones where we're focusing on the new launch vehicle where we would target something in the vicinity of $100 million and, hopefully, settle out something that's certainly under $200 million.

Mr. PERKINS. Now in terms of the number of uses, obviously at this time it is kind of preliminary when we're talking about 1999 deployment to realize how many times it is going to be utilized a year and even what the program is going to be calling for at that stage, but in terms of your initial looking and your long-term outlook, what do you forecast at this stage is going to be the necessary usage at that time when it comes on line?

Dr. LENOIR. From a NASA perspective we put as a placeholder about four times a year, which really means maybe two to four launches a year of NASA type missions, not DOD but NASA type missions, which would be heavy things. For example, our Advanced X-ray Astronomical Facility has gotten quite heavy. It is to be launched on a Titan 4. We could do a little bit more. Several of the missions we've just launched on the Space Shuttle could have done

more had they been able to grow. So we would anticipate science missions opening up with the larger facilities. But the primary focus for the heavy would be twofold: more, bigger capability for Space Station, enabling me to launch bigger things all at once; and growing beyond the Space Station to where the initial part of our Lunar re-exploration.

Future Lunar Operations

Mr. Perkins. At this time, has there been actually a commitment on the part of NASA to move beyond the Space Station towards a second Lunar operation?

Dr. Lenoir. That's also on the drawing boards for how we, with the Administration, define the exploration initiative and what kind of a time scale we want to put on it.

Mr. Perkins. But at this time the movement is towards Lunar operation as opposed, let's say, to a movement towards a Mars operation.

Dr. Lenoir. That's in our thinking, but that's far enough ahead that that is certainly not cast in concrete. The Tom Stafford's synthesis group will give us some additional insight and advice into that. We want to keep our minds open and not do anything that puts us to premature conclusions. But in a timing sense, it seems prudent to think in terms of Moon and Mars.

Shuttle Endeavour

Mr. Perkins. Okay. Briefly moving to Endeavour. Now when that comes on line, are there any substantive changes that we should know about that differs in any respects from the other Shuttles?

Dr. Lenoir. Let me just say a few and then ask Bob Crippen to add a couple of others. It, along with Columbia, will have the ability to support the Extended Duration Orbiter pallet for the consumables. And we have used the Endeavour development as a mechanism to bring in some new advanced systems; for example, the drag chute—help me, Crip.

Mr. Crippen. Besides the drag chute, we're also putting in redundant nose wheel steering. We have nose wheel steering in now that has just got one string. In other words, if one part of it broke, it is not available to us anymore, and we're going to put in redundancy.

Those are really the big new things. But from an appearance standpoint, you really won't be able to see much difference. The spectator looking at the vehicle, it is going to look pretty much the same.

We do have a number of new improvements though that we've got coming on line as a result of having—we've got new computers, in fact, we're going to be flying those this time; we've got new IMUs, our Inertial Measuring Units; we've got new star trackers. So we've taken advantage of this new vehicle.

Mr. Perkins. Are there any structural changes? Do you anticipate that you will begin to see the same sorts of cracking after 10 to 12 missions on Endeavour as perhaps we have seen in the other Shuttles?

Mr. CRIPPEN. Structurally, it looks the same as the previous vehicles 103 and 104, the Atlantis and the Discovery. There's slight modifications but very slight. In fact, we're using components that we've taken just this past week from the Endeavour down to Kennedy to repair the Discovery that we're pulling back from the pad. Meanwhile, we'll put in a new design to correct the deficiency that we found on these particular lugs that Doctor Lenoir discussed.

Mr. PERKINS. Okay. In terms of the overall lifetime expectancy, you're still talking about 100 missions; is that correct?

Dr. LENOIR. Yes. We haven't changed the design requirements.

Mr. PERKINS. Okay. Thank you very much, Mr. Chairman.

Mr. HALL. Thank you. We may have to push back our timer because it went off early on you, Chris. You didn't go over; it went off on you at three minutes. So you still have another minute if you'd like.

The Chair recognizes the gentleman from California, Mr. Packard.

SPACE STATION SCHEDULE

Mr. PACKARD. Thank you, Mr. Chairman.

With the downscoping of the Space Station, has the schedule for putting it out in space changed much?

Dr. LENOIR. I would say it has not changed much. The last thing that we're doing, similar to the launch system, is we're undergoing an internal independent review of our cost and schedule. We've had a little bit of criticism that maybe we're a little optimistic on our schedule, and it may change a little bit but not much.

Mr. PACKARD. And what is that schedule to start taking parts up?

Dr. LENOIR. It is not formal and official yet, but we will probably start constructing the Space Station in like the second quarter of fiscal year 1996. We would hope to reach a man-tended capability no later than the third quarter of 1997, hopefully earlier. And then during the fiscal year 2000, we would reach a four-man permanently manned capability. Now all of those dates we hope to beat, but we're currently talking those in order to allow ourselves a little bit of leeway.

Mr. PACKARD. And without a heavy launch, what is the plan to take it into space?

Dr. LENOIR. With the Space Shuttle. The two key differences that we are proposing in the restructured Space Station are to make the modules somewhat smaller so that I can outfit them fully and launch them fully outfitted instead of empty and have to outfit them in orbit. And in order to take full advantage of that, I require Advanced Solid Rocket Motors' additional performance in order to do that. And our current schedule does support that.

The other missions, what we have done is rather than build the structure truss work one stick at a time in a Tinker Toy fashion, we're building them up in pre-assembled segments on the ground from 30 to 45 feet long, integrating the equipment in it, totally checking them out on the ground, launching them in orbit, and deploying them fully assembled so I connect the consecutive ones together. Those can be done with today's Space Shuttle.

Space Shuttle Cost Reductions

Mr. Packard. It certainly does bring up the question that was asked earlier, and that is what is the validity then of the heavy launch and its timing. But we won't get further into that.

Earlier this year J.R. Thompson testified that he felt that we could cut back on the cost of launch services as much as 20 to 25 percent. I can't recall the justification of that. Do you have the same feeling and, if so, what is the justification for reducing the cost of launch?

Dr. Lenoir. I think we can reduce our costs, although I am not prepared to sign up for J.R.'s 25 percent.

Mr. Packard. We're talking about Shuttle launch.

Dr. Lenoir. I hadn't heard that. Yes, Shuttle. Twofold: one is the Space Shuttle system has relatively high fixed costs. Our operating and the fixed level is relatively high with a lower marginal cost, on a flight-by-flight basis. So I can reduce my apparent per flight cost by flying more. And as our rate goes up from six to eight to nine to ten, I will get some cost benefits just from that alone.

But over and above that, we are in the middle of a vigorous exercise today to study and challenge all of our processing requirements to make sure that we're not testing more than we need to at the Cape—if I'm testing at every flight, can I test at every other flight? What about every fifth flight? Maybe every tenth flight—in order to remove some requirements and to lower the manpower that is required, hence our costs. We are scrubbing our requirements and we found quite a bit already. And we will also be looking at it from a point of view of given the requirements, are we implementing them in the most efficient way or are we doing it a little bit circuitously which costs of, again, more manpower.

Mr. Packard. Will those cost savings be passed on to the customers, the payload customers?

Dr. Lenoir. We don't really have very many payload customers any more. They certainly would as we would compute our fixed costs, that would be part of our base. But we frankly don't have very many customers. You and the public are our real customers and they will be passed on because we won't have to pay as much.

Mr. Packard. I understand that on the commercial payload manifest that NASA is pulling some of those launches off from the commercial manifest and will plan to do them through NASA or Air Force. So I presume that there still are some commercial customers.

Dr. Lenoir. There are still some commercial customers, but I am not aware of any that had been commercial on a different vehicle that we're pulling back into our system.

Mr. Packard. I see. Maybe those are on expendable launch——

Dr. Lenoir. Yes, as a matter of fact, we're going the other way. In this budget cycle, we took two satellites that were scheduled to be deployed by the Shuttle and we decided to do them on an expendable launch vehicle instead.

Mr. Packard. The concern that the committee has, and I think you've heard it from several now and will probably continue to hear it, is the meshing of the timing, recognizing the high cost, of developing a heavy launch capability and meshing that with the

need for the heavy launch. It really concerns me that we are seeking to build a heavy launch facility and capability when, in fact, the need may be passed by the time that becomes a reality, and that's of concern I think to more than just myself.

Thank you, Mr. Chairman.

Shuttle Launch Costs

Mr. Hall. Thank you, Mr. Packard.

And just to add while we're there where we don't have to come back to it, and for the record, Doctor Lenoir, it is my understanding the fixed costs were about $1 billion per year plus the variable cost at around $50 million per flight. And after Challenger, the fixed cost is about $2.25 billion per year, with the variable going on up to $70 or $80 million per flight. Is that consistent?

Dr. Lenoir. I'll have to think my way through this answer. The average cost is $350 million, which is our total cost divided by the number of flights. And our marginal is in the vicinity of $50 million.

Mr. Hall. Is that based on how many flights a year?

Dr. Lenoir. That's on ten, so that's saying our total cost is about $3.5 billion, and of that a little over $500 million is variable costs. So our fixed costs are a little bit under $3 billion.

Mr. Hall. Okay. And if we have time, we'll get into some incentives that you may have for the contractors to find someway to lessen those costs, and you may have some ideas on that.

Dr. Lenoir. Yes, sir.

Mr. Hall. The Chair recognizes Mr. Rohrabacher from California.

Commercial Heavy-Lift Launch Vehicles

Mr. Rohrabacher. Thank you, Mr. Chairman.

Well there's good news and bad news. I guess I'll start with the good news in that I want to congratulate you and NASA for the decision of pulling back the Shuttle and being conservative in your approach and making sure that it is safety first. I don't think the country can withstand another shock of a Shuttle blowing up as we saw it. And I want to congratulate you for that. I know it is a tough decision because I know the Space program is under such scrutiny now, and I congratulate you for that decision. That's the good news.

The bad news is I have something of concern to me that I would like to ask you about. Doctor Lenoir, it is my understanding that section 103(a) and 1(b) of the NASA Authorization Act, which was signed by President Bush in November, is that NASA is mandated to study commercially-developed heavy lift launch vehicle proposals in addition to the Shuttle C and Shuttle C-derived heavy lifters. These studies would have to be distinct from any ALS or NLV or NLDP work that NASA might be doing since those studies are funded from totally different accounts and also since the ALS is not in any way a commercial proposal.

Now, Doctor Lenoir, looking at your fiscal year 1991 operating plan issued on December 13th of last year—and my staff has looked through this and I have looked through this—I don't see

your office planning to study anything that this Authorization of $10 million is supposed to be for other than the Shuttle C and Shuttle C-derived heavy lifters. What I want to know is are there other things, and why aren't commercially-developed heavy launch vehicle proposals being studied? I mean, we have several companies—McDonnell Douglas, Martin Marietta—who have made proposals, and it doesn't appear to me that NASA is actually taking our direction as was put forward in the law.

Dr. LENOIR. The money that you refer to I believe is the money that was fairly aimed at Shuttle C activities, is that correct?

Mr. ROHRABACHER. Well, it was fairly aimed at that but it was very specific that it would be other than just Shuttle C-derived. I mean, we wrote—believe me, we specifically wrote that language into the law because we wanted that study to be done. And I don't see anything in your—I have the law right here. And I don't see anything in what your plan is to actually study it. Can you tell me something, are there commercially-developed heavy launch vehicles that you are studying? ALS is not it. I mean, ALS is not a commercial proposal.

Dr. LENOIR. We still have our Shuttle C activities underway. We have not put the majority of that money into that activity yet, pending the outcome of the directed study with DOD to look at a national new launch system.

Mr. ROHRABACHER. Yes, but DOD is not a commercial—I mean, we're talking about a commercial proposal here. It specifically states in the law that you're to look at other than Shuttle C-derived commercial proposals. I just would like to—I mean, I'm sorry to have to hit this with you right in front of this hearing, but I guess that's the only place we can do it. I talked to Admiral Truly about it and he came back with the answer that it was ALS, and ALS is not a commercial proposal.

We put this in there, it is part of the law, you are being directed to do that, and I want to know, and perhaps you can send me in writing or perhaps you will have to start adding something new to your operating plan, but it doesn't look like your operating plan and from your answer, it doesn't sound like you're following our direction at all. It sounds like you're focusing totally on Shuttle C and Shuttle C-derived vehicles, and you're looking at ALS as your other alternative.

Dr. LENOIR. Let me propose that what we need to do is to go and to communicate back to you for the record exactly where that money is proposed to be spent and when and on what.

SHUTTLE C

Mr. ROHRABACHER. I would like you to in writing show me where, and if you can, I would appreciate that very much because anything that you're spending that money for that's a commercial proposal for a heavy lift launch vehicle is something I'm very interested in. That's what you were directed to do and I was very involved with making sure that was involved in the law and that's why I'm concerned about it.

Can you tell me why Shuttle C seems to be so expensive? I mean, from what you are saying it sounds like it is going to be just as expensive as another orbiter.

Dr. LENOIR. The Shuttle C numbers, our estimate for a complete Shuttle C that would support Space Station is somewhere between $3.5 and $4 billion. That includes the upper stage transportation to get the payload from orbit to the Space Station.

Mr. ROHRABACHER. What's the amount for just another orbiter then?

Dr. LENOIR. It is about $2.5 to $3 billion; $2.7 billion and——

Mr. ROHRABACHER. Well, why would a Shuttle C, which is supposed to be actually less costly and less complicated, why would it cost so much more?

Dr. LENOIR. It is the development. I don't have to develop an orbiter, I just go out and build one. But the Shuttle C cargo carrier, how the main engine, how many main engines, where they go, the avionics, the module that takes the place of the orbit maneuvering system and the reaction control system needs to be invented. It is new development that doesn't exist today.

Mr. ROHRABACHER. I thought that that was all supposed to be basically—that why we were looking at Shuttle C is because most of those questions were supposed to already solved via what we've done to develop Shuttle.

Dr. LENOIR. Most of the problems—I mean, the Shuttle would be a very, very expensive development if we had to do everything—way over $10 billion. All of that is done. What we have done is with hardnosed realism is to go in and penetrate the Shuttle C development and make sure we have properly estimated what it would really cost to develop; and that, along with the cargo transporter, that's about $3.5 to $4 billion.

Mr. ROHRABACHER. If I could ask one more question, Mr. Chairman, and that is this seems to be a major increase now in the estimate of what it is going to cost to develop the Shuttle C. Last year it was I believe much less than that, $1.5 to $2 billion. What's happened?

Dr. LENOIR. What's happened is we have done an independent assessment of that, have concluded that it was underestimated, it was estimated on too short a schedule, and in order to do something that supports the Space Shuttle, it doesn't have a cargo transporter which is almost a $1 billion all by itself. Shuttle C all by itself can throw a lot of weight into orbit but it can't get it to the Space Station, and that cargo transporter is required in addition to the basic launch vehicle of the Shuttle C.

Mr. ROHRABACHER. I'm sorry, I've run out of time——

Mr. HALL. We'll yield you an additional two minutes.

Mr. ROHRABACHER. Well, who did the first assessment? The first assessment was I think $1.2 billion to $2 billion. And now we just about have a double of that assessment. Who did that first assessment?

Dr. LENOIR. NASA.

Mr. ROHRABACHER. So NASA, with all of your expertise and all of the people who have been there for all these years involved in these programs, just underestimated by a half of how much it would really cost?

Dr. LENOIR. Unfortunately, that's true. We did not review that inside NASA before we released those numbers as much as we should have. What I term "our internal advocates" who want to sell the program were not properly challenged and we did not review the numbers with our non-advocates to the depth that we should have in order to challenge the cost estimates and the development schedule, as we have recently.

COST OVERRUNS

Mr. ROHRABACHER. Well, we could go on with this in great depth, Mr. Chairman. The only observation I have is we're talking about a lot of money that's been flushed right down the sewer. Whether it is Space Station or some of these other things, it just seems that money is flowing through here and we're not seeing any hardware. And every time we want to see the hardware, the prices seem to double and double and double; that went for Space Station and everything else. I guess when you talk about space it sort of flushes up, and that's what we've been doing as differentiated from some of the other programs here in Washington.

Thank you very much.

Mr. HALL. I think it is only fair to say that it is not unlike NASA to have overruns. I think they've had overruns from 20 percent to 100 percent in Space Transportation budget at times. I don't know causation or the cure for that, but I think it would be fair to give Doctor Lenoir a shot at answering that.

Dr. LENOIR. I thank you and we're aware of that. We have been criticized for programs that overrun significantly. We have made steps in the last two years to do our very best to acknowledge that and to make sure that we don't fall into that trap again. It is somewhat difficult because we come up to talk about a new program and you think it is going to overrun, so if we've done the right estimate and we have the right numbers, you think it is going to cost more than it is. But we're trying very hard to come up with the right answer the first time so that we can, as we said earlier, have stable and adequate funding and go back and spend all of our effort building that program instead of building the next revision to the plan.

Mr. NAGLE. Would the gentleman yield?

Mr. HALL. Does the gentleman yield? Did I hear Mr. Nagle?

Mr. NAGLE. I thank the gentleman for yielding. I was just curious to know if that new philosophy applies to the ASRM?

Dr. LENOIR. It does and that's why we're in internal review at this time.

Mr. NAGLE. Why? Is there a problem that generated the internal review?

Dr. LENOIR. Not generated by the internal review, but the dollars that were proposed for fiscal year 1992 were not what we had anticipated that we would propose. And rather than glibly say what that does to the schedule, we want to make sure that we understand in depth what it's going to take each year and what that buys us and when.

Mr. NAGLE. But sources tell me that the program has encountered serious cost overruns already. Is that true?

Dr. LENOIR. I'll be able to answer that much better in a month and a half.

Mr. NAGLE. I'll wait.

Mr. HALL. The gentleman never did yield, I don't think, Mr. Nagle. [Laughter.]

Mr. NAGLE. I apologize, Mr. Chairman. I move that all that be stricken from the record.

Mr. HALL. All right. [Laughter.]

The Chair recognizes Mr. Volkmer.

STRUCTURAL SPARES

Mr. VOLKMER. Thank you very much, Mr. Chairman.

I am sorry I wasn't here to hear your statement. I have reviewed your testimony. What I've heard here today gives me some serious qualms about the future of access to space, about when we get to the Space Station and for a while thereafter. Let me explain that to you.

As one who has been on the subcommittee and has been concerned with that space access, principally through the Shuttle, and now sees the Endeavour coming to us around the 1st of May, and sees a reduced amount than what you asked for in the budget for structural spares, I see no heavy lift capability to help with the Space Station. Now, how come we see a reduced amount first on structural spares?

Dr. LENOIR. Originally in our thoughts, the structural spares funding was a bridge, if you like, between Endeavour and the next orbiter. Now that we've decided not to request the next orbiter beginning with the fiscal year 1992, but certainly no earlier than fiscal year 1993 and probably later, the time that is appropriate to bridge is longer. So our strategy would be to take longer, to the point where I don't go so far that I'm not maintaining the capability to come back up and build orbiters, but I'm no longer trying to get ready for an early new start on the next orbiter.

Mr. VOLKMER. Now you're saying then that you feel that the $78 million is going to retain the capability of replacement?

Dr. LENOIR. I think it will help us to retain, but by itself it will not maintain that capability.

Mr. VOLKMER. No, it will not; you know it and I know it. And you also have the problem not only of the structural spares, but we have such things as Shuttle unique parts and we have subcontractors out there that are already down.

Now if we want to build another Shuttle and we're going to wait another two years to make that decision, and all we're doing is a few structural spares, where are we two years from now when we decide that we want another Shuttle?

Dr. LENOIR. It will cost more because there will be some vendors who have gone out of business, or vendors who are still in business but a process they no longer have, a product they make differently, and we will have to do some redesign and some recertification. That is one of the very bitter bullets that we have had to bite as we come together in a budget that fits.

Mr. VOLKMER. All right. And it is also a longer time frame. You are not going to do it in four years either.

Dr. LENOIR. That's probably correct.

HEAVY LIFT CAPABILITIES

Mr. VOLKMER. So now that takes me to what I see in a heavy lift. The scenario that I now see is that we're going to drop the Shuttle C; undoubtedly, that's gone by the wayside as far as any heavy lift capability to construct the Space Station. Correct or incorrect?

Dr. LENOIR. Premature. At this point, that's not the leading candidate. But we have not formally and officially between the DOD and the NASA arrived at what our program is. Shuttle C remains one of the options, although it is not the leading candidate at this time.

Mr. VOLKMER. How long is it going to take to build a Shuttle C; develop and build it?

Dr. LENOIR. About five years.

Mr. VOLKMER. Five years. I'll remember that. We're looking at a 1992 budget right now. We're not going to do it in 1992, so we're going to look at 1993. Five years from 1993 is 1998. We're not going to wait until 1998, surely, Doctor Lenoir, to start building a Space Station, are we? Is that what you're telling me?

Dr. LENOIR. We're going to begin building the Space Station with the Space Shuttle in 1995.

Mr. VOLKMER. When is it going to be completed?

Dr. LENOIR. The initial phases will be completed in the 1996 time frame and in the 1999 time frame.

Mr. VOLKMER. All right. Then all you have left then for heavy lift is a 1999 time frame; that's the earliest you can do it.

Dr. LENOIR. And beyond.

Mr. VOLKMER. And beyond. But that's the next question I have. It is unbelievable. What's beyond?

Dr. LENOIR. The completion of our plans on the Space Station growing from four people to eight and beyond, if the initial experiments prove that out; increasing the power from 55 kilowatts to 75 kilowatts to beyond, again, if the demand indicates that's the thing to do; and to grow the Space Station in an evolutionary fashion based on the results of the first five, ten, fifteen years of activity. The Space Station initial configuration permanently manned we would anticipate would be in 1999 or there about, but we would anticipate continuing to evolve it and grow it and add to its capability over the decades that follow.

Mr. VOLKMER. And you would use the heavy lift for that?

Dr. LENOIR. I certainly would, as well as the Shuttle, as appropriate for each one.

Mr. VOLKMER. All right. Other than that, the only thing that I could find a heavy lift for would be for our Lunar missions and those aren't going to start for at least 25 years, right?

Dr. LENOIR. For Lunar missions and also for very heavy science satellites.

Mr. VOLKMER. But what I am trying—I'll go back to my original thesis and what the concern I have is that in the 1995, 1996, 1997, 1998 time frame, all I have is my Shuttle. I've got four of them. We know—you know and I know that we're probably going to have problems with one of them in between time; there's a good proba-

bility of that. I do not have the capability of building another one really to help out because it is going to take me—if you wait too long, it is going to take four to five years. That's my concern.

Dr. LENOIR. Yes, sir. That's our concern as well. And our thought process was that we had basically two choices. We could take the choice that we did take, which is to favor the new launch system in the late 1990s, early 2000s, and take the risk that we don't totally support our requirements in the mid-1990s. I have four orbiters and if I can maintain all four operational throughout the decade of the 1990s, I've got no problems. If I lose the services of one, I'm getting very tight to meet my requirements. Should I lose the services of two, I can't meet them all, but that doesn't mean that the world stops, that means that things slow down. I can still build the Space Station, but things slow down.

Alternatively, if I don't anticipate and begin a new launch system at this time, let's say I need to back up my orbiters, I'll have a very robust orbiter and Shuttle system throughout the 1990s but I will not have put anything in the bank and at the year 2000 I will still be totally dependent on the Space Shuttle and have nothing that I can evolve and grow and go forward with.

Mr. VOLKMER. Is the reason that you do not go ahead with the Shuttle C the fact of the cost of it and not the need for it?

Dr. LENOIR. It's twofold: It is the operating costs are excessive, from our perspective; and that it has common components with the Space Shuttle to a large degree and doesn't offer us the independence that we would like, as well as frankly it doesn't provide the new technology—new engine, new avionics, as well as a total new vehicle—that we think are necessary to go forward and frankly provide the new technology to spin off into commercial industry hopefully for them to use in commercial launch vehicles that they would be developing.

Mr. VOLKMER. All right. Mr. Chairman, I know my time has run out. I want to ask Doctor Lenoir to submit for me in writing an estimate of the total cost in the years after 1995—1996, 1997, to 1997—of operation of the Space Station and cost of his proposed expansion of the Space Station in 1999, 2000, 2004–5, whatever it is, things that you recognize as the cost of that.

Dr. LENOIR. Okay. That will be part of our restructure assessment that we send up here within the next month.

Mr. VOLKMER. Thank you. Thank you, Mr. Chairman.

SHUTTLE C

Mr. HALL. I think along that for the record, the Shuttle C, I don't know whether to ask that by saying it carry any more than 160,000 pounds or it carries at least 160,000 pounds, which is as much as a heavy orbiter carries, right?

Dr. LENOIR. Yes, If we think of it in a Shuttle C sense taking cargo, then, for example, the Space Shuttle takes 50,000 pounds in round numbers to lower earth orbit. The Shuttle system itself can obviously take the weight of an orbiter, but I don't want to count the engines in cargo module itself as payload and I have to subtract that.

Mr. HALL. I think it also should be in the record that Chairman Brown, who is Chairman of the big committee of which we are only a subcommittee, has indicated he wants fewer Shuttle flights for the Station, and so then we would have to have the heavy lift orbiter by at least 1998. I won't ask you about the likelihood of that, but be thinking about it.

The Chair recognizes at this time the gentleman from Texas, Mr. Geren.

SHUTTLE LAUNCH RATES

Mr. GEREN. Thank you, Mr. Chairman.

Doctor Lenoir, in the last five years the Space Shuttle flights dropped 24 to 16 to 14 to 12, and they are now down to 10. What arguments would you be able to make to hold it at 10? What kind of pressure is there to support that position or are we going to see it continue to shrink?

Dr. LENOIR. I guess my best argument for 10 is to say that last year we planned to fly 9, we did fly 6, but we took almost half the year off with hydrogen leaks. All we have to do is to not have hydrogen leaks and we're operating at a 10 flight a year range. We believe we're there except for this most recent problem. But our operating experience for short periods of time is in the 10 flight a year range. What we need to do is to give ourselves the capability to continue that for the longer term.

Mr. GEREN. What do we lose when it goes from nine to six? What would be sacrificed if the number of Shuttles is pushed below ten? What areas would you see suffering from the cutback?

Dr. LENOIR. As part of this budget process, we did study numbers as low as 8. We get marginal in our ability to support the Space Station and we would have to slow the Space Station down potentially. We have many missions other than the Space Station that we couldn't support all of, either we would have to cancel missions, Space Lab science missions, or postpone them and stretch them way out.

Mr. GEREN. And OMB wanted you to drop it to 8, did they not?

Dr. LENOIR. I don't know that I would use the verb "wanted to," but they asked us to look at it. We looked at it; we showed them what 8 would look like, what 9 would look like, and what 10 would look like, and we converged on 10 being the correct answer.

Mr. GEREN. Did OMB, in asking you to look at eight, did they have any recommendations on who would suffer by the loss of those two, what programs would end up being cut back?

Dr. LENOIR. No, they just did it by taking money out and said look at eight a year, and it was our job to look at what that meant.

Mr. GEREN. How many flights do you need each year to support the Space Station?

Dr. LENOIR. In our restructure assessment, we're looking at about four flights a year to assemble it. Independent from that in the 1990s, after the first year, maybe two or three per year to use it; and those would be in replacement of currently booked Spacelab flights, so those would not be new ones. So I don't know whether you want to call that four or six to seven.

Effects of Shuttle Operations Consolidation

Mr. Geren. Thank you. Let me jump subjects a little bit on you. As you discussed earlier the Augustine Report has recommended the Space Shuttle operations should be consolidated at Kennedy Space Center. How many jobs do you believe that would require to be transferred from Houston to Florida?

Dr. Lenoir. We haven't looked at it in that depth. What we're looking at initially are the functions that could be transferred there, and we're concentrating at the management level within the Government. That would indicate that we're not looking at large numbers of jobs making the move. That the jobs that are in the Houston area are in the Houston area because they support the mission operations, things that happen during the flight. Crew training, Mission Control, that's not going anywhere; that's staying in Houston.

The jobs that happen in the Huntsville area tend to happen around the payload integration and the payload operations. That's not going anywhere. We're talking about the management of the development projects—the orbiter project, the external tank project. Maybe we should look at moving our managers to the Cape. Similarly, at the Cape, the jobs that are associated with processing the hardware, the Shuttle and the payloads, obviously stay there.

I don't envision a lot of jobs moving so much as responsibilities shifting.

Mr. Geren. When will you be in a position to make a final recommendation on this?

Dr. Lenoir. We have given ourselves I believe until late September–October is when I have to make my final recommendation to Admiral Truly as to what the plan is that I would recommend that we implement.

Mr. Geren. Thank you very much, Mr. Chairman.

Mr. Hall. The Chair recognizes the gentleman from Florida, Mr. Lewis.

Solar Dynamic Technology Funding

Mr. Lewis. Thank you, Mr. Chairman.

Doctor Lenoir, last year in S. 2887, the NASA Authorization Act, which President Bush signed into public law, there is a requirement for you to submit to this committee not later than May 1st of this year a plan to conduct a flight plan for solar dynamic technology. In the Hud-Independent Agencies Appropriations Act for the current fiscal year there are $10 million which are fenced so as to be only available for Solar dynamic technology. Will you tell us at this time what the status of the plan and the expenditure of the $10 million are?

Dr. Lenoir. As you know, we're in the middle of a Space Station restructure that, along with that $10 million, I believe $109 million for the Flight Telerobotic Servicer. Of a total of $1.9 billion for the Space Station that we were instructed to come back to the Space Station that was consistent with that $1.9 billion. And a total of $6 billion less over the next 6 years than we had originally anticipated.

Internally, we have completed that within the Space Station Office and we are not reviewing that within NASA and we're very close to coming forward through the Space Council, back from NASA, to the Congress answering that.

The Space Station program we are proposing has neither a Flight Telerobotic Servicer nor a Solar Dynamics component to it, not because we don't love both of them, but we just can't stretch the money far enough. We are in both cases investigating within NASA how we can transfer those from the Space Station program to our research and technology, and to investigate these as a technology development activity. And Arnie Aldrich I know is studying, from the Solar Dynamics perspective, in response to a couple of hints that we have gotten from Members of Congress as to what that ought to contain, and he is trying to put together exactly a program that does that.

Improve Cost Estimates

Mr. Lewis. Okay. I was listening to your answer to questions of the gentlemen from California and Oklahoma. I get very much concerned and I think you put us in a terrible position so often, but how can we have faith in your programs and estimates when they continue to overrun? For example, Shuttle C, as the gentleman from California pointed out, appears to have doubled from $1.5 to $2 billion to $3.5 to $4 billion. It is very difficult, very frustrating to realize we should have the best scientists, mathematicians, technicians, engineers, and, yes, administrators who are the people that come up with this cost estimates. So why can't we get a better cost estimate. It would seem after 10 years of Space Shuttle flight and 30 years of space flight that we ought to be able to do a better job. It puts us into a very difficult position, I think, as members of this committee and other Members of Congress as well, in order to support a viable space program and when we can never hang a dollar on it. I think the greatest travesty is the Space Station program; the way that thing has changed and changed and changed.

I don't know whether it is because you are all under political pressure from the various committees of Congress or what it is, but if it is somebody is going to have to come forward and say so and we're going to have to get this thing straightened out because if we don't we're never going to be able to sell the space program and its advantages to the American public, let alone to our friends overseas. I'm not saying these things because I don't have a tremendous admiration for NASA and you and Crippen and Admiral Truly and all the others, because I do, and I have a lot of faith in you. But somewhere along the line, we're slipping. Since the Challenger accident, which was a very tragic situation, you've been placed in the forefront of a lot of things. But I really feel we have got to get a better shake on these cost estimates and we can't go from year to year and have them increase at this tremendous cost. As you know, the dollars are not there.

If we're going to have what we feel is the best space program in the world, we're going to have to do a better job and we're just not doing it, but we've got the people capable of doing it. I just had to make that observation, Doctor Lenoir. I'm certainly not throwing a

shot at you or anybody in particular, but I just feel we have to have a better job done.

Dr. LENOIR. I appreciate those comments, sir. Let me make a couple of remarks about that. On the Shuttle C, one of the things we have to be careful when we compare different numbers is that we're comparing the same program underneath it. Earlier estimates of $1.5 to $2 billion should be compared not to the $3.5 to $4 billion, but more like $2.5 billion, because that earlier Shuttle C was just a raw launch vehicle. In order to be useful to the Space Station, that payload has got to be delivered to the Space Station. That's going to add about $1 billion to $1.5 billion to whatever it was. So I need to compare that $1.5 to $2 billion earlier number to $2.5 billion or a little bit more. Admittedly, that's a significant growth and we need to worry about that.

What's happened is in the past couple of years NASA's perspective has changed. We are not as optimistic as we previously had been that would assume coming in with a program, then everything is going to go exactly right and we don't have to worry about. We are trying to allow time for things not working exactly as anticipated and having more money.

The Space Station has been a different problem. In trying to break out of that vicious circle has been what I've spent two years trying to do. Two years ago, for the fiscal year 1991 budget, we were proposing $2.9 billion. And in getting the fiscal year 1990 number through the Congress, it was suggested to us that $2.45 billion was a lot more reasonable; we could not get $2.9 billion, although the year before we had a program that showed $2.9 and that was a run-out and we planned to run out. So we built our plan anticipating that we would ask for $2.45 in 1991, and we replanned. Then when we came into the 1991, we didn't get $2.45 billion, we got $1.9 billion, and instructions as to cut down on the rest of it for the next six years. That broke us back to our current replanning, the restructure of activities.

The good news is if the guidance for the next six years, which is way down from our original appetite is, in fact, reality, then maybe for the next three years every year we can be implementing the same program. The Space Station has not overrun in the last two years; it has reacted to budgets that were less than it had asked for. Now maybe our initial request is never realistic, but the facts are that those budgets were not actually obtained and we had to replan, and when we replan and take longer, it costs money.

Mr. LEWIS. Isn't it a fact though that part of what you need for Shuttle C to increase the cost is the OMV and that you cancelled that last year?

Dr. LENOIR. We need something of a capability to transfer cargo from the launch vehicle to the Space Station. Yes, we did cancel an OMV last year. We cancelled it for two reasons: the first and foremost was we had more on our plate than we had money for. Our Space Shuttle main engine enhancements were costing more than we had anticipated because we had underestimated what it would take to get those through development and through testing; and there was no more new money and OMV had been a program that had been in trouble. It had doubled and then doubled again and was overrunning and we cancelled it.

Mr. LEWIS. Doctor Lenoir, it would seem to me that you would the caveats very necessary on some of these things, and particularly I think sometimes you're placed in a position to say you're going to do something that marginally you don't think you can but you are going to give it your best shot. Then you have to come back and say you can't do it. It would seem to me that even if you had to hurt our feelings up here and tell us we just can't do it, if we can tell you a way to do it, tell you. But I just think, as I mentioned earlier in my comments, that you're politically being pressured into committing to things that is very marginal or we're just not doing a good job in our cost estimating and it is going to have to be done because the public out there do not understand the technical reasons for an increase in cost. They just know what that headline tells them—Shuttle costs more, we can't do this, we can't do that because it's going to cost more, or double last year's cost. It is very difficult to sell these programs that way.

Dr. LENOIR. Yes, sir. And we agree and we're trying very hard, but we would appreciate your help. I might offer one counter-example and that's Endeavour, which will be delivered in May to the Cape, it was fully funded in 1986-87, I guess it was, and never had to worry about whether next year's budget was going to support it, and we were able to lay out a schedule, build it according to that schedule, and it has underrun significantly.

Mr. LEWIS. Well, Doctor Lenoir I'm completely familiar with that particular program. You did a good job but you did it mainly because we had a lot of spare parts available that we could also assemble to do the job.

Well, I've used up my time, Mr. Chairman. I thank you for your candor, Doctor Lenoir. Thank you, Mr. Chairman.

Mr. HALL. I thank you. And thank you, Doctor Lenoir.

Is there anyone else who wants to be recognized? Oh, Mr. Nagle. The Chair recognizes Mr. Nagle.

HEAVY LIFT LAUNCH VEHICLE

Mr. NAGLE. I thank the Chairman.

I am not necessarily with maybe, other members of the committee on the reservations about the new HLV or the HLLV system. Just looking at a cost and scheduled assessment prepared by David Bates of the NASA Headquarters, dated February 15th, 1991, I noted that there appears to be in the new HLLV—I confess, I don't know what HLLV stands for, but the HLV or whatever it is appears to be a lot of new technology. Is there a conscious reason behind NASA's decision to move in that direction as opposed to restructuring the Saturn V or going back to the Shuttle C?

Dr. LENOIR. I wouldn't say that we have a lot of new technology, but certainly one of the advantages of a new launch system is the ability to put technology that's up-to-date in there. The specific new technology, of course, is the new engine. This country has not built a new big engine in over two decades. And a new clean burning engine is new technology. New avionics that's up-to-date with today's capabilities frankly won't cost us any more to develop than it would to go back and redevelop the Saturn V avionics, although

it will provide us more capability and be significantly more beneficial to commercial industries.

So, yes, indeed, we have set out to, where appropriate, insert new technology so that we can continue to move forward.

ASRM

Mr. NAGLE. I don't want to cause the Agency to reevaluate it; I told you I agree with you, I do think you're on the right path in that direction.

Now, let me ask you about my favorite toy, the ASRM, if I could. I'm told by some sources that there are the three new developments in the development of the ASRM. First is it's lift capacity is not what we've been told but, in terms of payload capacity, it's going to be half; second is there is significant cost overrun; and the third is there's going to be significant delays in that program. Is the ASRM encountering those three mentioned difficulties?

Dr. LENOIR. Let me take them one at a time. Let me make sure that Crip keeps me honest here. With respect to the performance, I'm not aware of any performance problems that we've run into. We had said that the ASRM Shuttle flights will provide 12,000 pounds more capability in low earth orbit than the current redesigned solid rocket motors. To the best of my knowledge that's still true, and that's up to and including the 5th of February when we had our last executive quarterly review in Sacramento at AeroJet.

Mr. NAGLE. Doctor Lenoir, if we're going to be perfectly candid with the committee, we acknowledge that of that 12,000 pound lift capability that we project at this time, only 6,000 of that would go to payload under current estimates; isn't that true?

Dr. LENOIR. No. From an ASRM perspective, their requirement is to deliver that 12,000 pounds to me. What I have done with that 12,000 pounds is I have stuffed 2,000 pounds in my back pocket and said, there, I want to hang on to that because I don't know where things are going. I've given Cripp 2,000 pounds, saying I know that the Space Shuttle main engine enhancements are heavier than the old Space Shuttle main engines to the tune of about 2,000 pounds, so here's 2,000 pounds. And then I have told the payload community—from our perspective, that's largely Dick Kohrs, you can count on 8,000 pounds. And that's how we've taken the 12,000 pounds and divvied it out. But that 12,000 pounds is still 12,000 pounds.

Mr. NAGLE. So but in payload capability, we're at 8.

Dr. LENOIR. Yes, but that's a plus 8.

Mr. NAGLE. I understand that. But it's plus 8 and if I had figures from other sources that said plus 6, would I be in the ball park?

Dr. LENOIR. Yes, to the extent that 6 is close to 8, but I fully expect to deliver 8,000 pounds and more. [Laughter.]

Mr. NAGLE. Okay. All right. And in cost?

Dr. LENOIR. With respect to—let me take the cost and schedule together since obviously they're not independent. As I explained earlier, in going through this budget cycle, we have submitted a lower request for ASRM in fiscal year 1992 than had been anticipated in our fiscal year 1991 budget run-out. And this was a late development, as we tried to come together with the budget and in negotiations with the Office of Management and Budget—we had

requested of the OMB the same number that we anticipated in 1991, and in our negotiations with them it was made clear that that's nice and they would love to support it, but they don't have that much money, so we've had to request a smaller number.

We have a study going on internally right now, a reassessment of what does that mean both from two perspectives—if that's the number that we get, what does that mean for schedule; and first indications are it's probably in the six to eight month time frame, but we're not willing to stand up behind that yet. And the other question is if I wanted to hold my schedule and maintain an August 1996 first flight date, how much more money would that require. And, again, we don't know but first indications are that's in the $150 million range in 1992. Fiscal year 1992 is going to be a very tough year. It is not at all obvious that we'll find that.

Mr. NAGLE. The project status report furnished to me NASA dated March of 1991, that's this month.

Dr. LENOIR. We delivered that today, yes.

Mr. NAGLE. Yes. It would indicate that the initial project estimate for the ASRM cost was $2.179 billion. The project and status report as of March 1991 indicates it has gone to $2.550—$2.5—$2.65 billion. So we are about a half a billion up from what the original cost was.

The same document furnished to me indicates that the initial project estimate on launch date first flight was 1984, project completion was fourth quarter 1995, and this PSR indicates that that date now has to be determined at TBDs. That would indicate to me that we're half a billion dollars up already and we're apparently going to slip from 1995 sometime on into the future, the date yet to be determined. Is a fair reading of your own report?

Dr. LENOIR. Yes, it is. And that $2.55 billion is an estimate that's basically the run-out of the fiscal year 1991 budget that will grow, especially if we stretch it out.

SHUTTLE MAIN ENGINE

Mr. NAGLE. Okay. One last question, Mr. Chairman, with the leave of the Chair.

A report furnished to me from the independent assessment of Shuttle accidents scenario probabilities on the Galileo mission, the last such report I believe was prepared by NASA, indicates that there is a 60 percent greater chance of failure on the current main engine than there is on the RSRMs. The question I would like to close my conversation with you today is if we have got a 60 percent greater chance of failure on the main engine than we do on the current RSRMs, why in the world aren't we putting a greater effort into repairing the main engine than we are into a project that is now a half a billion dollars over initial cost and a date to launch that we don't even know when at this time?

Dr. LENOIR. We've put very high priority on exactly that subject with a series of Space Shuttle main engine enhancements, the first series of which is scheduled to be implemented in 1994, the second series is tentatively booked in at about 1996. That first sequence would have alternate turbo pumps, a two duct power head, a new heat exchanger, all of which are addressing potential failure modes

in the main engine. The second series would entail an advanced fabrication scheme in the wide throat engine. We have put a great deal of attention on that. This summer we anticipate putting into the fleet the enhanced Rocketdyne extended duration pump so that we can get more flights out of the current turbo pumps as they have been redesigned in order to give us more life time and subsequently to keep us safer longer.

So we have not ignored the main engine. We have identified main engine enhancements and to the best of our ability have set out to implement each and every one that we think has passed the technical screen for being viable and cost-effective.

Mr. NAGLE. Well, you furnished us a report—with the leave of the Chairman—you furnished us a report November 16, 1990, in which you evaluated our specific request for a report on the implementation of the Aerospace Safety Advisory Panel's—your progress in terms of making their progress on their safety concerns, and the initiatives that seem to have received an inadequate response were the use of an enlarged throat diameter nozzle on the Space Shuttle main engine and modifying the structure of the aft skirt of the solid rocket booster. I am just kind of curious to know is there a plan to get that open enlarged throat diameter going here or are we looking at 1995, 1996, 1997, 1998?

Dr. LENOIR. We're looking at 1996 and beyond as part of our initial kick-off on the assured Shuttle availability. Their unhappiness is that we don't do it soon. We just flat don't think we have the wherewithal to do it sooner.

There is also in this go round a little concern that we—let me think, how do they say it—they want us to make sure that we don't hurry up our test program. They've been pushing on us to get them into the fleet faster and now I sense they are beginning to get a little cautious that they don't want us to go too fast and have us bypass the adequate testing, and we certainly do not intend to go too fast and bypass testing.

Mr. NAGLE. The only thing I would note—and I don't want to be a critic, I like the direction you've taken on the HLV, I like the restructure of the station, as I've seen it—but the only thing I would note is that it took this committee specific legislative language to force NASA, not you personally, but to force NASA generally to start implementing the reports of the ASAP. That causes me concern. I guess I will always remain a critic of advancing an ASRM over repairs of the main engine. To me, where you have a 60 percent chance of failure greater with the main engine, that ought to receive with any agency a higher priority.

Do you have a date for me—last question—do you have a date for me when you will have the next PSR on the projected costs of the ASRM, the launch date of the ASRM, and the re-evaluation of the lift capability of the ASRM as it pertains specifically to payload?

Dr. LENOIR. The next Project Status Report for the ASRM will be I believe due in July, and it will be in there.

Mr. NAGLE. Thank you, Mr. Chairman. I have another round if you're going around again.

Mr. HALL. Well, we'll do our best to get back to you.

The gentleman from Alabama, Mr. Browder.

Assured Shuttle Availability Program

Mr. Browder. Thank you, Mr. Chairman.

Doctor Lenoir, last year this committee authorized the creation of an Assured Shuttle Availability program. At that time, we restricted the program to making only safety-related improvements in Space Shuttle flight and ground hardware. Can you please tell us why we should not impose a similar restriction this year?

Dr. Lenoir. The Assured Shuttle Availability program that we have proposed focuses on keeping the Space Shuttle a viable launch vehicle well into the next century. If you were to put a restriction on it that said we could only focus on safety-related issues, we would have to invent something else in order to deal with obsolescence of our systems and our equipment. For example, the early things that we are looking at—the displays in the orbiter, the cathode ray tubes, some of the tape meters—are experiencing increased maintenance requirements.

If I look at the Spacelab, for example, the data display units that malfunctioned on the Astro mission, and the cathode ray tubes that support those, those were provided by European industry as part of the Spacelab program. Those are no longer manufactured. NASA owns all of the remaining cathode ray tubes that support the Spacelab mission. We know exactly when they are going to expire; when they're broken we won't have any more. That's the type of thing that we want to address across the entire program, see it coming early enough, as we have in this case, to develop an alternative in a cost-effective manner. And in that Spacelab case, we're proposing to use our on-board general payload support computer, a grid compass computer today, to support Spacelab in the future.

But we want to identify those even though they are not safety-related but that they will cost us significantly in maintenance or our ability to fly early enough that we can develop, work around, and not have that problem. And that's a large part of what Assured Shuttle Availability is all about. It also addresses safety issues.

But what I don't want to do is I do not want to take the responsibility for safety away from the individual project and subsystem manager. Individual subsystems and individual projects are responsible for the safety of their product and they don't depend on a different program to find the money. If they have a safety issue, as with the main engine, fix it and put it in the budget and put it in line right up front.

Mr. Browder. As you now envision the program, what percentage of the funds will be used to make safety-related improvements?

Dr. Lenoir. That's going to be a hard question to answer. For example, one of the likely kick-off activities is advanced fabrication and a wide throat engine for the Space Shuttle main engine. We have it in there because we think that that's an Assured Shuttle question, that from a manufacture ability and a fabrication I want to be able to manufacture these easier with fewer welds, inspect them, and be flyable more often. No question, that's also directly supportive of safety. An awful lot of what we do is going to be both.

Separate Management of Space Shuttle and Space Station

Mr. Browder. I would like to ask you about something else, too. The Augustine Report recommends that NASA separate the management of Space Shuttle and Space Station programs into different offices. Could you please describe to us where we are on that.

Dr. Lenoir. I have asked each of my program and each of my Center directors to categorize everything they do and put it in one of two buckets—development or operations. And I will be reporting back a preliminary set of thoughts to Admiral Truly about two weeks from now. And I believe it is two months from now, three months from now, excuse me, a final recommendation for how we deal with that recommendation.

I am trying very hard essentially to take my job and turn it into two—to have an Office of Space Flight Operations, and an Office of Space Flight Development—in such a way that we don't cause the Space Shuttle program any disconnects from a safety sense. And that's the main concern. Other than that, it is easy. We know what's development, we know what's operations, but the Space Shuttle operations depends in a day-to-day sense on access to development engineering, and figuring out how to do that is our challenge. We're committed to implementing that requirement.

Mr. Browder. Thank you, Doctor Lenoir. Thank you, Mr. Chairman.

Mr. Hall. The Chair recognizes the gentleman from Pennsylvania, Mr. Walker.

Commercial Launch Vehicles

Mr. Walker. I thank the gentleman.

Do we have a pretty good idea as to what the tonnage is we want to lift to orbit by say the end of the decade?

Dr. Lenoir. I can't give you the number, but, yes, we do.

Mr. Walker. We have that pretty well in mind. Has anybody given any thought as a part of what we're doing to say that these are the requirements that we have at the end of the decade, would people like to come forward and tell us ideas that they have to get that tonnage to orbit—primarily the commercial community I'm talking about.

Dr. Lenoir. No, I understand what you're saying. What we have done is we put together our overall strategy for launch vehicles, Space Station assembly, and so on, is to say that we know what vehicles exist today. There is a point of view that says commercial industry can develop things more efficiently than the Government, and I don't know whether you're a proponent of that or not, but even if it's true, they can't do it a lot faster. So that if it doesn't exist today, it is very difficult to image it in existence much before 1997-98, if we're optimistic.

Mr. Walker. Well, that may be, but my main issue is one of there are a number of fairly unique ideas kicking around out there that go well beyond some of the technology that we have traditionally thought about in this area. For example, SDIO has suggested that there are single staged orbit vehicles that would be well worth looking at. I think some of the leading aerospace firms, like McDac,

for instance, have even looked at proposals and think that it is at least technologically feasible to do.

Do we have any planning money? I mean, have we gone to them, suggesting to them that we would have use for such a vehicle, should it be built, or are we locked in to doing things that we've already decided as designs need to be done rather than looking at the much broader field that may exist?

Dr. LENOIR. We're not locked into anything at this point. We do have some planning money; it is not a lot of money, not as much as anyone would like. Frankly, I look at some of these single staged orbits—Sealaunch, et cetera—with a jaundiced eye, just as we now look on our own, just as what we've been discussing earlier has apparently driven up the cost of Shuttle C, has taken concepts of a new launch vehicle and made them more expensive than initial thoughts, is to be very much of a hardnosed realist and not believe the first marketing from us within NASA, within the Government, or the contractor base. No, we have not specifically gone out and said I have X amount to give to orbit, do you have an idea. We do talk in terms——

Mr. WALKER. With limited money, wouldn't that be a reasonable thing to consider doing just to find out what's out there?

Dr. LENOIR. We intend to do that from a point of view of supporting the Space Station, but largely with existing capability because I'm talking about something that performs in the late 1990s not something that's still on the tail end of development.

Mr. WALKER. Well, but I'm a little bit puzzled by that because the fact is that if you went the route of upgrading technology that we now have, like Shuttle C and so, we still wouldn't know the performance envelop of that. I think your earlier testimony indicated that we probably, if we started today, wouldn't have that available to us much before the late 1990s.

Dr. LENOIR. About 1997, at the earliest.

Mr. WALKER. Yes. So the fact is that we wouldn't be very much behind the curve to find out whether or not some people out there have a low tech approach or a high tech approach, or a single staged orbit, or whatever it is. I'm just a little puzzled why we seem to be moving toward locking ourselves in. And the only reason why I said locking ourselves in, I'm not suggesting that you've done that, but virtually every time that we're in meetings with NASA folks over this issue of the next generation of vehicle we hear Shuttle C as the proposal that they are putting forward. It sounds to me at least there has been a tentative decision that's the direction they want to go. Maybe it is the right decision, but it seems to me there are some other concepts that at least deserve some consideration.

Dr. LENOIR. We'd like to think we are open-minded and are not at all honed in on Shuttle C and are looking at alternatives.

Mr. WALKER. I mean, is single staged orbit one of the alternatives you're looking at?

Dr. LENOIR. To the extent that we're open-minded. We do not have a specific proposal on the table from anybody that says here's a Shuttle, has single staged orbit developed to the same depth as our other alternatives.

Mr. WALKER. But you're not likely to get that at the outset. I mean, no one is going to have one that is developed as you would, for instance, Shuttle C because you already know certain component parts of Shuttle C. So I mean that becomes an impossible test for anybody to meet at the outset if that's your criteria.

Dr. LENOIR. We're not comparing just to Shuttle C, we're comparing to a new launch vehicle that is Shuttle derived but not Shuttle C that has more growth potential. The SDIO has been funding and supporting our activities, looking at single staged orbit, sea launched vehicles, and so on. The SDIO has been an integral part of the Advanced Launch System program office with the Air Force, SDIO, and the NASA, and have been representing those capabilities and what they have learned with their dollars.

Mr. WALKER. Yes, but I will tell you again, just because of the decisions that we get involved in in the policymaking front, they feel as though—at least I shouldn't say SDIO does—Air Force feels as though there is a competition here, a competition basically within the National Space Council on who's idea is ultimately going to get funded. Now competition may be a great concept. In this case though it may also be locking out certain options that are available to us and that gives me some concern.

The consideration of infrastructure to support heavy lift options or alternative options, is that given high priority in what you're looking at? In other words, reducing the amount of infrastructure that would be necessary in order to support a launch vehicle?

Dr. LENOIR. Absolutely. The operating launch costs on a per launch basis are one of the prime things that we worry about that frankly mitigates against the Shuttle C. Being very heavy Shuttle derived also brings higher operating expenses and we're trying very hard to get well under that.

Mr. WALKER. I thank you, Mr. Chairman.

SPACE SHUTTLE COST REDUCTIONS

Mr. HALL. And we do thank you.

I think to close, I think I express the subcommittee's feelings when I quote J.R. Thompson again saying "it would be possible to reduce the cost of operating the Shuttle program by up to 20 to 25 percent." The only thing that would sound better than that from a Deputy Administrator would be to hear the Administrator say that he had cut 20 to 25 percent out. I'm told, or I've heard that that could be done; that there are layers of supervision and management that is expensive and unnecessary. I know you look for that and you will look for that.

It has also been suggested that NASA continue first of all to place the very highest possible importance on quality and especially on safety. You and Captain Crippen, having known the value of the safety factor, but for NASA to look for incentives to provide contractors who are legitimate, honest people in 99 percent of the time with incentives to cut some costs out, even by the form of allowing them to keep a percent of every dollar they save, whatever, but some innovative and aggressive form of saving money is very much in order at this time.

We thank you, and thank you for your history and your past, and for the contributions you have made, and for the testimony that you've given here today. We will not go a second round, but we will ask you to answer questions that members who are here who would like a second round and members who are not in attendance that would like to make some inquiries of you, that you answer those and submit them back and we will put them in the record.

Dr. LENOIR. And we'd be happy to do that.

If I might add a word in response to your last comment that the 25 percent reduction in operating cost will not happen all at once. We take that as a goal. I would anticipate that we would have as our target, our benchmark, saving 3 to 5 percent per year for about 5 years because we have to do it in a way that maintains our safety and we have to do that very carefully.

With respect to industry, we have asked our industry, our major contractors, we have asked Dan Telip, the chief executive officer of Lockheed, who are our Shuttle processors at the Cape, and Don Beal, the chief executive officer of Rockwell, our chief hardware contractor to work together along with our other contractors and give us some ideas, to come back to us with any ideas that they can come up with. Our goal is to be more efficient, to regularly fly 10 times a year, and to be efficient and less expensive in doing it.

Mr. HALL. And our goal is to cooperate with you and to help you.

Is there anything further that you'd want to say to the committee, Doctor Lenoir or Mr. Lyons or Captain Crippen?

Dr. LENOIR. I would just like to thank this committee for its support over the years, and to say that our success very much depends on your continued support. We stand by to help you in every way that we can.

Mr. HALL. Thank you very much, gentlemen.

Our next witness will be Ms. Stephanie Lee-Miller, Director, Office of Commercial Space Transportation, from the Department of Transportation.

We welcome you, Ms. Lee-Miller.

STATEMENT OF STEPHANIE LEE-MILLER, DIRECTOR, OFFICE OF COMMERCIAL SPACE TRANSPORTATION, DEPARTMENT OF TRANSPORTATION; ACCOMPANIED BY NORMAN BOWLES, ASSOCIATE DIRECTOR FOR LICENSING PROGRAMS, DEPARTMENT OF TRANSPORTATION

Ms. LEE-MILLER. Mr. Chairman, this is my first opportunity to testify before this committee under your chairmanship. I look forward to working with you and appreciate meeting you this afternoon.

Mr. HALL. Thank you.

Ms. LEE-MILLER. We appreciate the opportunity of addressing the subcommittee today on the fiscal year 1992 budget. And as you indicated, I am submitting for the record, our detailed budget request. However, I would like to focus my remarks on a few recent launch activities and regulatory developments.

As was noted earlier in this session, the Augustine Report called for a robust transportation capability. And certainly we at DOT are

in the business of supporting transportation efforts and we're committed to implementing the spirit and intent of not only the Augustine Committee but the history of this subcommittee by advocating the inclusion of commercial space transportation service providers whenever and wherever possible.

So far so good. Last year was a busy and successful year for the U.S. commercial space transportation industry. We saw growth in terms of launch activities, also in terms of developing policies which support the development of a strong, competitive space transportation industry. This month we're celebrating the second anniversary of the U.S. License program, which this committee has provided authority for. And last year, 11 successful DOT licensed commercial launches too place. This year, we're expecting more than that. We have on our DOT commercial launch manifest 35 more launches expected over the next few years.

However, I regret to inform you, Mr. Chairman, that on our commercial launch manifest, we are experiencing a few changes. As a result of a recent Justice Department decision, we are going to implement that decision which will result in decline of the commercial launch activities from the projected 35 launches we had to 30. We have, however, issued 19 launch licenses up to this point.

We are also streamlining the requirements for our regulatory program to include efficiency. And this really involves our changing—I don't want to say change, but let's say evolve in the way that we handle the licensing program. For example, last month we issued the first operators license to General Dynamics. This is authorizing General Dynamics to carry out its commercial launch program down at the Cape for a two-year period. In the past, we have had a system where companies applied for a license on a launch-by-launch basis. As of this commercial operators license, they are authorized to conduct a series of launches and have authority to operate from the range for a consistent amount of time on an annual basis.

We also have just issued an NPRM which proposes a user fee schedule for commercial launch license applicants. This schedule includes a license application fee, an annual renewal fee of $2,500, a variable per-launch fee of about $2.50 per pound of payload delivery. This particular user fee was developed in response to congressional language on the part of the Appropriations Committee which directed us to implement this program, as well as OMB and the Department's request.

We see a lot of interest growing in the commercial space area, particularly with leadership coming from States. And I think this is a very exciting development. In addition to Hawaii and Florida, with Florida, particularly, having a history in providing commercial and launch activities, we see Hawaii now involved in advocating their interest in promoting spaceport development and other kinds of launch facilities on the island. In addition, State Governments in California, Colorado, Texas, Virginia, and other States have gone about forming an association. So we now have an Aerospace States Association promoting space enterprise.

We see growing interest coming out of the private sector. Motorola has announced plans to develop a commercially-launched constellation of 77 telecommunications satellites which will establish a

new telephone network, and Orbital Sciences came through with a new vehicle, the Pegasus, demonstrating that the private sector can excel at new technology research and development.

I think the events of the first couple of years have shown that U.S. commercial launch companies are competitive and reliable participants in the commercial launch market. However, it remains to be seen whether our good start can be translated into staying power. It is my belief that we are moving down the right track; however, I do believe that there are some roles that the Government must play to ensure that we act as a reliable customer and that we really provide the necessary support for this industry to continue to grow.

The Office of Commercial Space is also very involved in advocating U.S. trade policies. And this is an area that we spend a good deal of time with the U.S. Trade Reps office in working with the other spacefaring nations. Last week we had a session with the Europeans to develop rules of the road that will apply to participants in the world's commercial marketplace. We are also looking forward to extending these discussions to include the non-market economy players so that there is a level playing field for industry.

Mr. Chairman, in the document I submitted for the record, I go into the details regarding the budget request. I really won't go into all of that at this time. So that concludes my opening comments. I would be happy to answer any questions.

Mr. HALL. We will put your entire statement in the record, if you'd like.

And this is your first time to testify here before me. I'm impressed. You did a good job.

Ms. LEE-MILLER. Thank you.

[The prepared statement of Ms. Lee-Miller follows:]

REMARKS OF STEPHANIE LEE-MILLER
DIRECTOR, OFFICE OF COMMERCIAL SPACE TRANSPORTATION
BEFORE THE HOUSE SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

WASHINGTON, DC
MARCH 7, 1991

* * *

LET ME BEGIN BY THANKING YOU, MR. CHAIRMAN, FOR THE OPPORTUNITY TO ADDRESS THE SUBCOMMITTEE TODAY ON THE FISCAL YEAR 1992 BUDGET. ON BEHALF OF SECRETARY SKINNER, LET ME SAY THAT WE AT THE DEPARTMENT AND OFFICE OF COMMERCIAL SPACE TRANSPORTATION (OCST) LOOK FORWARD TO WORKING CLOSELY WITH YOU IN THE COMING YEARS TO SHAPE OUR NATION'S FUTURE IN SPACE.

* *

OCST IS REQUESTING A TOTAL OF $5,104,000. FOR FISCAL YEAR 1992. PLEASE NOTE THAT THIS FIGURE INCLUDES AN ASSUMPTION THAT OCST WILL RECEIVE $300,000. IN USER FEES AS MANDATED BY CONGRESS AND THE OFFICE OF MANAGEMENT AND BUDGET. I WILL FIRST DETAIL THE MAJOR ACTIVITIES AND PROGRAMS OF OUR OFFICE AND THEN CONCLUDE MY REMARKS WITH A DESCRIPTION OF REQUESTED PERSONNEL AND TRAVEL FUNDS.

A TOTAL OF $3,500,000 IS REQUESTED FOR THE RESEARCH AND SAFETY PROGRAM, TO BE ACCOMPLISHED THROUGH A VARIETY OF CONTRACTS AND GRANTS. THE FOLLOWING IS A BREAK-DOWN OF PROGRAM REQUIREMENTS BY CATEGORIES AND THEIR SUB-COMPONENTS:

A. SAFETY OPERATIONS ($925,000.)

THIS CATEGORY INCLUDES ACTIVITIES UNDERTAKEN TO PROTECT PUBLIC HEALTH AND SAFETY AS MANDATED BY CONGRESS IN THE COMMERCIAL SPACE LAUNCH ACT AND AMENDMENTS THROUGH REGULATION AND LICENSING OF LAUNCH OPERATIONS AND SITES.

1. LICENSING OPERATIONS ($450,000.)

THE WORKLOAD OF THE OFFICE HAS INCREASED WITH CHANGES IN THE INDUSTRY. THE REVIEW AND APPROVAL OF LAUNCHES OF NEW VEHICLES SUCH AS AIR-LAUNCHED SYSTEMS, REENTRY VEHICLES, AND COMMERCIAL LAUNCH SITE PROPOSALS ARE MORE COMPLEX THAN THE PROPOSALS TO LAUNCH EXISTING DESIGNS FROM CAPE CANAVERAL. THEREFORE, THE LICENSING PROCESS IS BEING REDESIGNED AND IMPROVED IN ORDER TO ENABLE OCST TO HANDLE GROWING LEVELS OF COMMERCIAL LAUNCH ACTIVITY AND INCREASINGLY COMPLEX INITIATIVES IN AN EFFICIENT MANNER.

ALSO, AS INDIVIDUAL STATES SUCH AS HAWAII, MISSISSIPPI, AND OTHERS REQUEST SAFETY EVALUATIONS OF THEIR SITES TO DETERMINE WHETHER THEY CAN BE LICENSED, THESE EVALUATIONS PLACE NEW RESOURCE AND TECHNICAL DEMANDS ON OCST'S ENGINEERING STAFF.

2. INSPECTION REQUIREMENTS ($325,000.)

THE MODIFICATION OF THE LICENSING PROCESS TO INCLUDE PROGRAMS OF LAUNCHES UNDER ONE LICENSE WILL RESULT IN MORE OF OCST'S RESOURCES BEING DEVOTED TO COMPLIANCE MONITORING TO ENSURE THAT THE REQUIREMENTS OF THE LICENSES ARE MET.

3. ACCIDENT/INCIDENT INVESTIGATION SUPPORT ($75,000.)

FUNDS ARE REQUIRED FOR OCST TO CONTINUE TO DEVELOP PROCEDURES AND GUIDANCE AND TO PROVIDE TECHNICAL SUPPORT FOR ANY INVESTIGATION.

4. LICENSE, INSPECTION/ENFORCEMENT AND COMPUTER SYSTEMS ($75,000.)

INCREASES IN SPACE TRANSPORTATION ACTIVITIES WILL BRING MORE LICENSE APPLICATIONS, INSPECTIONS, INVESTIGATIONS AND ENFORCEMENT ACTIVITIES. THESE SYSTEMS WILL BE USED TO TRACK AND ANALYZE LICENSE AND REGULATORY ACTIVITIES.

B. SAFETY PLANNING AND RESEARCH ($1,675,000.)

TO ESTABLISH THE BODY OF KNOWLEDGE NECESSARY TO SUPPORT THE REQUIREMENTS OF THE COMMERCIAL SPACE LAUNCH ACT AND AMENDMENTS THERETO;

TO DEVELOP EFFECTIVE AND EFFICIENT SAFETY STANDARDS AND REGULATIONS; AND TO PROVIDE GUIDANCE TO THE COMMERCIAL LAUNCH INDUSTRY CONCERNING REGULATORY ASPECTS OF NEW LAUNCH AND PAYLOAD CONCEPTS.

1. COMMERCIAL INFRASTRUCTURE AND OPERATIONS ($1,225,000.)

THE RAPID GROWTH IN THE NUMBER OF LAUNCHES AND THE DEVELOPMENT OF NEW LAUNCH VEHICLE CONCEPTS AND PAYLOADS, INCLUDING REENTRY SYSTEMS, HAS SIGNALLED THE ARRIVAL OF A COMMERCIAL INDUSTRY. COMMERCIAL LAUNCH SITES ARE UNDER CONSIDERATION OR DEVELOPMENT IN HAWAII, FLORIDA, AND MISSISSIPPI; THEY HAVE BEEN DISCUSSED IN STATES SUCH AS ALASKA, VIRGINIA, AND TEXAS. OCST WILL HAVE TO IDENTIFY ISSUES AND EVALUATE SELECTED OPTIONS TO ENSURE THE SAFETY OF EXISTING AND FUTURE COMMERCIAL LAUNCH SITES.

A. COMMERCIAL OPERATOR QUALIFICATIONS & CERTIFICATION ($400,000.)

IT WILL BE NECESSARY TO ESTABLISH CRITERIA FOR REENTRY SITE ACCEPTABILITY AND NECESSARY QUALIFICATIONS AND CERTIFICATIONS FOR OPERATING PERSONNEL.

B. EVALUATION METHODOLOGIES FOR COMMERCIAL SAFETY PRACTICES ($300,000.)

COMMERCIAL RANGES UNDER DEVELOPMENT WILL EMPLOY UNIQUE PROCEDURES. THUS, NEW TYPES OF VEHICLES AND PAYLOADS, INCLUDING REENTRY SYSTEMS, WILL RESULT IN THE NEED TO CONSIDER SAFETY-RELATED OPERATIONS AND PROCEDURES.

C. SAFETY AND RELIABILITY OF HARDWARE SYSTEMS ($275,000.)

THE ADEQUATE DESIGN AND RELIABILITY OF SAFETY-RELATED HARDWARE SYSTEMS IS A FUNDAMENTAL ELEMENT IN PROTECTION OF PUBLIC HEALTH AND PROPERTY. RESEARCH WILL BE DIRECTED AT THE REQUIREMENTS FOR TELEMETRY AND TRACKING FOR LAUNCH VEHICLES, REENTRY VEHICLES, AND LAUNCH SITES.

D. COMMERCIAL PAYLOAD SAFETY ($250,000.)

MANY PAYLOADS CONTAIN TOXIC, RADIOACTIVE, OR OTHER HAZARDOUS MATERIALS AND MUST BE REVIEWED BY DOT TO DETERMINE WHETHER THEIR LAUNCH WOULD JEOPARDIZE PUBLIC HEALTH AND SAFETY, SAFETY OF PROPERTY OR ANY U.S. NATIONAL SECURITY OR FOREIGN POLICY INTEREST.

2. ENVIRONMENTAL ISSUES ($200,000.)

AS A REGULATORY AGENCY, OCST IS RESPONSIBLE FOR COMPLIANCE WITH THE NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) AND THE CLEAN AIR ACT OF 1990, AND HAS ISSUED ENVIRONMENTAL IMPACT STATEMENTS (EIS) FOR COMMERCIAL ACTIVITIES AT EXISTING NATIONAL RANGES AND GUIDELINES FOR EIS DEVELOPMENT FOR FUTURE COMMERCIAL SPACEPORTS. OCST IS IN THE PROCESS OF COMPLETING A JOINT FEDERAL/STATE ENVIRONMENTAL IMPACT STATEMENT WITH THE STATE OF HAWAII. SIMILAR ARRANGEMENTS HAVE BEEN INITIATED WITH FLORIDA AND OTHER PROPOSED COMMERCIAL LAUNCH SITES. IN ADDITION, THE POSSIBILITY OF OFF-SHORE LAUNCH FACILITIES; INTRODUCTION OF DIFFERENT VEHICLES; PAYLOADS CONTAINING BIOLOGICAL MATERIALS, NEW SUBSTANCES, AND HAZARDOUS MATERIALS; AND THEIR RETURN TO EARTH RAISES NEW ENVIRONMENTAL ISSUES AND REQUIRED REVIEWS THAT WILL BE ADDRESSED BY THIS RESEARCH.

3. ORBITAL SAFETY ($250,000.)

THE DEPARTMENT OF TRANSPORTATION IS THE FEDERAL AGENCY RESPONSIBLE FOR STUDYING THE COMMERCIAL REGULATORY OPTIONS AND ECONOMIC IMPACTS OF ANY DEBRIS REDUCTION REQUIREMENTS IMPOSED ON THE COMMERCIAL SPACE TRANSPORTATION INDUSTRY. OCST WILL DETERMINE COMMERCIAL SPACE TRANSPORTATION FACTORS THAT AFFECT ORBITAL SAFETY AND CONSIDER VARIOUS REGULATORY ACTIONS DESIGNED TO MITIGATE POTENTIAL HAZARDS.

C. INDUSTRY POLICY AND PLANNING ($800,000.)

KEY GOALS OF THIS DIVISION INCLUDE THE FOLLOWING: TO DEVELOP POLICY INITIATIVES IN ORDER TO FOSTER COMMERCIAL SPACE TRANSPORTATION BY THE U.S.

PRIVATE SECTOR, AS DIRECTED BY THE COMMERCIAL SPACE LAUNCH ACT, AS AMENDED; TO IDENTIFY NATIONAL SPACE COMMERCIAL LAUNCH VEHICLE AND INFRASTRUCTURE NEEDS AND TO ASSESS ALTERNATIVE MEANS OF MEETING THOSE NEEDS; TO ANALYZE CURRENT AND EMERGING ECONOMIC AND POLICY ISSUES IN ORDER TO FACILITATE THE EMERGENCE OF A STRONG, COMPETITIVE U.S. COMMERCIAL SPACE TRANSPORTATION INDUSTRY; AND TO ADVOCATE FREE AND FAIR INTERNATIONAL COMPETITION IN COMMERCIAL LAUNCHES.

1. COMMERCIAL AND GOVERNMENT SPACE LAUNCH TRENDS ($140,000.)

OCST WILL ANALYZE THE CRITERIA USED BY DOMESTIC AND FOREIGN PAYLOAD OWNERS TO SELECT PROVIDERS OF LAUNCH SERVICES, INCLUDING RESPONSIVENESS TO CUSTOMER NEEDS, RELIABILITY, AND RAPID RESPONSE CAPABILITIES. THIS ANALYSIS WILL DETERMINE WHETHER U.S. GOVERNMENT POLICIES ARE SERVING AS MARKET BARRIERS TO INDUSTRY AS IT SEEKS CUSTOMERS. THIS ANALYSIS WILL EXAMINE CONCERNS ABOUT MARKET BARRIERS AND PROVIDE A BASIS FOR ANY RECOMMENDED CHANGES IN U.S. POLICIES.

2. SPACE LAUNCH SYSTEMS ANALYSIS ($180,000.)

OCST WILL CONTINUE TO ASSESS U.S. AND FOREIGN LAUNCH SYSTEMS AND WILL MONITOR THEIR MARKETING, PRODUCTION, AND PRICES. OCST WILL ALSO MONITOR COMPLIANCE WITH INTERNATIONAL AGREEMENTS RELATING TO COMMERCIAL SPACE TRANSPORTATION, SUCH AS THE U.S./CHINA AGREEMENT.

3. SPACE TRANSPORTATION ANALYSIS AND RESEARCH (STAR) DATABASE ($200,000.)

OCST USES THE STAR DATABASE IN ITS ONGOING ANALYSIS OF U.S. GOVERNMENT POLICIES AFFECTING THE COMMERCIAL LAUNCH INDUSTRY.
THE DATABASE, WHICH CONTAINS INFORMATION ON LAUNCH VEHICLES, LAUNCH SITES, LAUNCH PROVIDERS, LAUNCHES, AND PAYLOADS, WILL BE UPGRADED AND EXPANDED.

4. REGULATORY IMPACT ANALYSIS ($140,000.)

OCST IS REQUIRED TO ANALYZE THE ECONOMIC IMPACTS OF PROPOSED REGULATORY ACTIONS ON ALL ENTITIES POTENTIALLY AFFECTED BY SUCH ACTIONS. OCST WILL USE THE FINDINGS AND CONCLUSIONS OF THE ANALYSES TO SUPPORT ITS GROWING NUMBER OF LICENSING AND OTHER REGULATORY INITIATIVES.

5. ECONOMIC CONVERSION ($140,000.)

OCST WILL ADDRESS ISSUES ASSOCIATED WITH MAINTAINING OR RE-DIRECTING CRITICAL INDUSTRIAL CAPABILITIES THAT HAVE BEEN FOCUSED PRIMARILY ON MEETING MILITARY REQUIREMENTS. OCST WILL USE THE FINDINGS AND CONCLUSIONS OF THE ASSESSMENT IN ONGOING POLICY DEVELOPMENT ACTIVITIES.

D. PROGRAM SUPPORT ($100,000.)

OCST WILL CONTINUE ITS MANDATE UNDER THE COMMERCIAL SPACE LAUNCH ACT TO PROMOTE AND FACILITATE THE GROWTH OF A ROBUST, COMPETITIVE U.S. COMMERCIAL SPACE TRANSPORTATION INDUSTRY AND WILL ALSO CONTINUE PROMOTING AWARENESS OF ITS ACCOMPLISHMENTS. THE OFFICE WILL ALSO CONTINUE RESPONDING TO A GROWING NUMBER OF REQUESTS FOR INFORMATION FROM CONGRESSIONAL AND OTHER GOVERNMENT OFFICES, THE PRESS AND THE PUBLIC.

1. INDUSTRY ACTIVITIES ($65,000.)

OCST WILL UNDERTAKE AN AGGRESSIVE OUTREACH PROGRAM THROUGH ACTIVE PARTICIPATION IN INDUSTRY CONFERENCES, TRADE SHOWS, SEMINARS, EXHIBITS, AND OTHER INDUSTRY-RELATED FORUMS.

2. PUBLIC LIAISON ACTIVITIES ($15,000.)

OCST WILL WORK FOR GREATER PUBLIC UNDERSTANDING AND SUPPORT FOR THE U.S. COMMERCIAL SPACE TRANSPORTATION INDUSTRY AND INCREASED KNOWLEDGE OF THE CONTRIBUTION IT CAN MAKE TO THE DOMESTIC ECONOMY. THROUGH THE GENERAL NEWS MEDIA, BOTH PRINT AND ELECTRONIC, THROUGH PARTICIPATION IN PUBLIC MEETINGS, AND THROUGH THE CREATION AND DISTRIBUTION OF INFORMATIONAL MATERIALS, THE OFFICE WILL EDUCATE THE PUBLIC ABOUT THE IMPORTANCE OF THIS

INDUSTRY TO BOTH THE ECONOMY AND NATIONAL SECURITY.

3. EDUCATION INITIATIVE ($20,000.)

TO FULFILL THE SECRETARY OF TRANSPORTATION'S AND THE PRESIDENT'S INITIATIVE TO INCREASE THE NUMBERS OF WOMEN, MINORITIES, AND DISADVANTAGED IN THE TRANSPORTATION WORK FORCE, OCST WILL WORK WITH UNIVERSITIES, OTHER EDUCATIONAL INSTITUTIONS, INDUSTRY AND COMMUNITY GROUPS TO MEET THIS GOAL. OCST WILL HELP FOSTER A GREATER AWARENESS OF SPACE TRANSPORTATION AS A POTENTIAL CAREER THROUGH GREATER USE OF THE DEPARTMENT OF TRANSPORTATION'S SERVICE ACADEMIES AND TRAINING INSTITUTIONS AND WILL PROMOTE COOPERATIVE PROGRAMS WITH UNIVERSITIES IN COMBINATION WITH PUBLIC AGENCIES AND THE PRIVATE SECTOR.

E. PERSONNEL AND TRAVEL

A TOTAL OF $1,506,000 IS NECESSARY IN PC&B TO FUND 25 FTES, TO ANNUALIZE THE JANUARY 1991 PAY RAISE, FUND A PROPOSED JANUARY 1992 PAY RAISE AT 4.2% AND NORMAL WITHIN-GRADE AND MERIT PAY INCREASES. THIS IS AN INCREASE OF TWO FTE AND $220,000 OVER THE FY 1991 ENACTED BUDGET. THE REQUESTED STAFF WILL SUPPORT THE COMMENSURATE INCREASE IN LICENSING, MONITORING, ENFORCEMENT, AND POLICY ACTIVITIES.

AN INCREASE OF $38,000 OVER THE TRAVEL REQUIREMENTS IN FY 1991, FOR A TOTAL OF $98,000, IS REQUESTED FOR TRAVEL.

THANK YOU AGAIN FOR THIS OPPORTUNITY TO ADDRESS THE SUBCOMMITTEE TODAY, MR. CHAIRMAN, AND I WILL BE HAPPY TO ANSWER ANY QUESTIONS FROM YOU OR YOUR COLLEAGUES.

# #

Mr. HALL. We might start off by recognizing Mr. Rohrabacher for California for any questions he may have.

COMMERCIAL LAUNCHES

Mr. ROHRABACHER. Thank you very much, Mr. Chairman.

Ms. Lee-Miller, could you let us know a little bit about the potential and how it may or may not be affected, commercial space development, in terms of its relationship to NASA. Aren't there some conflicts that you have at this time with turf battles at NASA that might greatly affect the potential of commercial space development?

Ms. LEE-MILLER. First, let me start out by introducing Norm Bowles who is Associate Director of Licensing, which I neglected to do at the outset.

NASA has a range of activities, of course, as we heard from Doctor Lenoir. You had here yesterday Jim Rose from the NASA Commercial Programs Office, an excellent program. And my office works very closely with Jim Rose in the implementation of that program.

NASA has been directed through presidential policy not to maintain an ELV adjunct. In other words, NASA has been directed, in our view at DOT, to refrain from operating and controlling launch services, but rather relying on and turning to the provision of commercial launch services from private companies. However, in this discussion of what constitutes a Government launch versus a commercial launch, there has been considerable dialogue, and before this very committee. You've engaged in this dialogue in the past.

During 1990, we were unable to resolve some of these issues involving what constitutes a commercially-provided launch versus a Government-controlled launch. So we then had the matter referred to the Justice Department.

Mr. ROHRABACHER. Can you tell us why that's important to make that determination?

Ms. LEE-MILLER. It is significant to make a determination of what constitutes the launches because we're really trying to establish consistent and reliable Federal policy for industry. Industry has to have their marketing strategy reliable. For example, General Dynamics just conducted their first, what we considered to be, commercial launch and they are marketing around the world. I have a brochure here which I can share with you which touts General Dynamics first commercial launch. It is important for the Government to show that we have confidence in commercial launch companies and their ability to provide these launch services. Why is it important? Because our companies are going before foreign governments trying to sell them commercial launch services. If the U.S. Government doesn't feel that the private launch companies are reliable and are able to provide launch services that are efficient, and timely, and accurate, then this is a considerable marketing disadvantage in the international marketplace. So we really feel it is significant from a marketing perspective.

There are also benefits that come to the company based on the establishment of the Commercial Space Launch Act, and those benefits come in the form of a one-stop-shopping regulatory program.

Our office has been authorized by this committee to establish a series of safety regulations and procedures that the companies then comply with. We are the only agency that has this regulatory regime.

Mr. ROHRABACHER. So, if it is determined to be a commercial launch, you can basically provide the companies with one-stop process. But if it is determined not to be a commercial launch, then it would be a much more complicated process?

Ms. LEE-MILLER. Yes. The companies then are under different agency requirements and procedures. We also have under the Commercial Space Launch Act a risk management system through the licensing process which establishes insurance levels for the companies. In the absence of a licensed launch, the Government agency is then assuming that risk and liability for that launch which does not have coverage of insurance under the Commercial Space Launch Act.

So as I was indicating earlier, Mr. Congressman, the Justice Department decision, which was recently issued several months ago, sets up a requirement that if a Government agency is substantially involved in the management of its launch, it is therefore exempt from the Commercial Space Launch Act and does not require a license. That has resulted in a number of launches, five to be exact, having been reviewed as being substantially controlled by the Government agency and, therefore, no longer commercial launches.

I think this is a step backwards in terms of what the intentions, as I understood it to be, on the part of this committee to really provide support for a robust, reliable, growing commercial space transportation sector.

Mr. ROHRABACHER. I just would like to say that I think when space exploration and space utilization is really going to take off is when people are permitted to make a buck out of it, and not just a buck dealing with a Government agency, but a buck at establishing profit-making enterprise that will make profit by dealing with consumers and do something for us on earth.

I know that your efforts are very vital to establishing that and getting that process going. I am looking forward to working with you to make sure that you're successful.

Thank you.

Ms. LEE-MILLER. Thank you.

Mr. HALL. Mr. Rohrabacher, thank you very much.

The Chair recognizes the gentleman from Iowa, Mr. Nagle.

Mr. NAGLE. No questions, Mr. Chairman.

Mr. HALL. The Chair recognizes the gentleman from Pennsylvania, Mr. Walker.

SMALL LAUNCH VEHICLES

Mr. WALKER. Thank you, Mr. Chairman.

I want to follow-up on where Mr. Rohrabacher was going because you made a comment right at the end of your remark indicating that you thought this was a step backward in where we had been. I couldn't agree with you more. This is a major step backward from where this committee thought we were going with regard to commercial space. It was our intention that NASA and other Govern-

ment agencies would in fact engage in the commercial market for those things that could be handled by the commercial market. That's where we were. And when I see a list of the satellites that NASA has now pulled off the list for licensing, I'm appalled.

And if I understand correctly, they have also indicated that the small launch vehicles may also be included in this coverage. If there is one place where we had some vitality in the commercial marketplace and where people are talking about putting together a basis for launching of vehicles and where there is a real potential market out there, it is in the small vehicle launch area, and it appears to be as though NASA is going to try to back us out of some of the commercial activity in that area. And I will find that absolutely appalling. Would you comment on this situation?

Ms. LEE-MILLER. Well, it is my understanding that the MELV and SELV launches are considered to be launches that will require substantial Government control, and those would be exempt under the OLC opinion.

Let me also just indicate that as an Executive Branch Agency, we are bound, and certainly intend to implement, the OLC opinion as it has been issued. As an Executive Branch Agency, those opinions are binding and we certainly must proceed to comply with that. So I don't mean to imply that——

LICENSING

Mr. WALKER. Well, how did that come about? My concern about the Justice Department opinion is I doubt the Justice Department has a similar opinion on how we haul freight over the highways. My guess is that when the Government decides to put something aboard a truck, we don't have to have an opinion from the Justice Department to decide whether or not we can utilize the truck. And yet, all of a sudden we've got this opinion, and I'm sure it's based upon insurance costs and that sort of thing, but all we do is certify that the trucker has insurance. We've got provisions for that in contracts. If we put it aboard a train, we assume the train has the proper insurance. And we certainly are not issuing opinions of this type every time some Federal official gets aboard an airplane.

Now that is the kind of regime that we had in mind of establishing for space operations. And it appears to me that we are backing far, far away from where this committee thought we were headed.

Ms. LEE-MILLER. Well, in the instance of setting insurance requirements, of course that is a responsibility of our office for commercial launches and we work with the companies to set those requirements. There are also launches still on the manifest that do involve Government payloads. There are Navy UHF follow-on launches, and SDIO has launches as well. So DOD has worked with our office and we have been able to work out a system of managing the risk aspects of the launches——

Mr. WALKER. So DOD has been cooperative on this and they feel that they are in compliance with the Justice Department's ruling. But is it NASA that has not been cooperative?

Ms. LEE-MILLER. The instance of what constitutes a launch that is substantially controlled has the agency discretion. There are features in the contract that are looked at in terms of how the con-

tracts are negotiated and the agency is able to exercise those instances where they feel substantial control is warranted and where——

Mr. WALKER. Well, but obviously SDIO, because of the nature of their programs, is substantially involved in whatever you list for them. It is just the nature of the program.

What you seem to be telling me is that in the nature of SDIO, they feel perfectly comfortable operating under your licensing procedure and launching under that procedure, yet when we go to a goes satellite, NASA has now pulled that out of your jurisdiction and has decided to take that over on their own. It sounds to me as though you're getting cooperation from some Government agencies in terms of going commercial, and you're not getting much cooperation from other agencies in going commercial. That's what I'm trying to figure out. Is that the case?

Ms. LEE-MILLER. Well, in 1990 SDIO launched a LOSAT satellite on a McDonnell Douglas launch vehicle and it went just fine.

Mr. WALKER. Okay. And they did it within the confines of the ruling of the Department of Justice?

Ms. LEE-MILLER. We did not have that ruling at that time. This ruling is new.

Mr. WALKER. Has DOD or SDIO raised that ruling as a potential for them pulling out of commercial launches in the future?

Ms. LEE-MILLER. Not at this time.

Mr. WALKER. Not at this time they haven't, and yet NASA has come in now and taken five launches away from the commercial sector; is that right?

Ms. LEE-MILLER. Based on the information that we've received and that the companies have been notified by letter that these licenses that I've indicated, and I have the five launches for you, will not require licenses, that's correct. We have been notified of that.

Mr. WALKER. I say once again, this is a major step backward and one that I think this committee is going to have to look into and perhaps issue some specific instructions.

Ms. LEE-MILLER. I wanted to bring this up before this committee because of course we release our manifest to the press on a quarterly basis, and I think it is important that as this issue evolves we not miscommunicate with the committee in terms of which way things are going here.

Mr. WALKER. Thank you, Mr. Chairman.

INSURANCE FOR GOVERNMENT LAUNCHES

Mr. HALL. Thank you. The gentleman from Pennsylvania either mentioned or brought out the word insurance. The Government traditionally indemnifies itself, doesn't it, rather than purchasing insurance because it is cheaper if the Government self-insures. Why should launches of Government payloads not be self-insured. I ask that because I am about to ask about the increase in your 1991 budget.

Ms. LEE-MILLER. Okay. Norman, do you care to respond to that?

Mr. BOWLES. Mr. Congressman, not all of the Government payloads that we will be licensing this year and next are self-insured. In fact, the Navy UHF satellites are being acquired under an

agreement where the Navy has gone to Hughes and asked for a delivery on orbit and those satellites are insured.

The SDIO launches also carry insurance, maybe not for the payload but they do carry insurance for Government property and third party liability.

Mr. HALL. So then are you saying that launches of Government payloads should be self-insured by the Government or we should purchase insurance? Isn't it more costly to purchase insurance?

Mr. BOWLES. I believe that's a risk management decision that's being made by the different agencies based on what they believe is important to their program needs.

Mr. HALL. Well, other than your office, who benefits when launches of Government payloads are issued licenses and commercially insured—the Government, the launch vehicle industry, the insurance industry?

Ms. LEE-MILLER. Certainly, the presence of insurance—there has been some discussion about the Government itself going into the marketplace and purchasing insurance and not always electing to self-insure because of course the Government then is taking the risk.

Mr. HALL. And saving money. It is usually cheaper for the Government to self-insure.

Ms. LEE-MILLER. This is true. And, of course, insurance is in case there's an accident. So——

BUDGET REQUEST FOR OCST

Mr. HALL. Well, the word insurance came up. Let me get to your budget. Your 1991 budget was $3.4 million and your 1992 request is $5.1 million; that's a considerable increase, exactly a 50 percent increase in your 1991 budget. Why do you need that increase?

Ms. LEE-MILLER. The last year, Mr. Chairman, this committee authorized $4.5 million, which was the President's request for the budget. However, the House Appropriations Committee reduced us by 25 percent and approved the $3.3 million level. So what we are asking for is really a restoration of the funds that were cut in fiscal year 1991 and a 6 percent increase over that restoration level of $300,000.

The impact of the 25 percent cut that we are living with in 1991 is being sorely felt by the office in this operational year. As I indicated in my remarks, there are a number of States that are very interested in commercial space enterprise, and our office has been authorized by this committee to provide services to the community of space activity that seeks those services. So we have found ourselves having to decline to get involved at the request of various States in helping them to determine the feasibility of their State getting involved in space enterprise.

Mr. HALL. Really, licensing is your main activity, isn't it?

Ms. LEE-MILLER. We have three statutory obligations: the regulation, promotion, and facilitation of this industry. And the promotion and facilitation task take the form of supporting and responding to the commercial space industry as it grows and evolves.

Our licensing program goes forward and the Appropriations Committee did indicate that they viewed that the licensing func-

tion was of course—and we view it the same way—is the priority. But they did not place similar importance in the area of international competition, for example. The Appropriations Committee seriously cut our capability to participate in policy formulation with regards to the international marketplace.

Now the industry, if they were here, would tell you that's their big priority. The industry is absolutely getting the ground cut from under them by the Europeans. They are absolutely worried about the Chinese and the Russians dumping launch vehicles into the marketplace, and providing launch services at $20 million under anything that they can do. So this cut that we took impedes our ability to participate in the international policy arena, working with the U.S. Trade Rep's office.

We have a requirement also established through this committee of monitoring the People's Republic of China Agreement. There is a launch agreement between the U.S. and China where they are required to compete fairly internationally. Well, the monitoring of that agreement takes considerable resources. Again, this cut has cost us in being able to provide those kinds of resources.

So we are asking for a restoration. We are asking for this committee to validate again the importance of DOT being able to advocate on behalf of the commercial space transportation industry in the international marketplace, and also being able to consult and provide technical expertise to these States that are coming in—Alaska, California, Texas. Texas is interested in establishing a landing site for the COMET program that Jim Rose told you about yesterday. Well, in the process of establishing this landing site, they are coming to us. This committee wrote language in the last NASA authorization bill advocating that DOT, directing us to work with the States and others in establishing public-private infrastructure partnerships. And you directed us to get involved and look at what the infrastructure requirements might be for commercial. This is an area that we think is also a very big priority.

We have in the statute authority to license commercial spaceports; that's in the Commercial Space Launch Act. If we are going to license commercial spaceports, which don't exist right now, there is a lead time. When the States come in they require safety analysis. For example, two years ago my office participated with Hawaii in doing a safety study about their potential spaceport. We couldn't do that today if Texas came in and said we want a study of the depth that Hawaii was able to receive. We would have to say no. We wouldn't be able to respond to that.

So that's why we are asking for a restoration of the funds that we were cut by in 1991 and a 6 percent increase. Now the 6 percent increase that we are requesting really has to do with the increase in actual launch activity. In 1989, there weren't any launches—I'm sorry, there were two. In 1990, we had eleven. In 1991, we're looking at seventeen. This all requires an increase in activity in the office.

Mr. HALL. Well, let me get back to my original question. Licensing is your main activity, you have other ancillary and other statutory duties, but licensing is your main activity.

Ms. LEE-MILLER. Yes.

Mr. HALL. And about what percent of licensing as your main activity does—the budget request that you make. what percent of that is attributed to your licensing?

Ms. LEE-MILLER. Two-thirds.

Mr. HALL. Okay. What was your budget in 1990, do you remember?

Ms. LEE-MILLER. I don't——

Mr. HALL. If not, you can submit it later.

Ms. LEE-MILLER. I don't have the number in front of me. It was $4 million—$4.3, I believe, in 1990.

Mr. HALL. Okay. So you had $4.3 and you had a request for $4.5 that was——

Ms. LEE-MILLER. Actually, I have the number here. The actual budget was $4.061 in 1990.

Mr. HALL. Okay. And then you were cut back to $3.4 for 1991, with the 25 percent cut that was put on the Floor I think.

Ms. LEE-MILLER. Yes.

Mr. HALL. But then you are requesting $5.1 now, which, according to my figure, is more than 6 percent, substantially more than 6 percent of even the $4.5. Are you leading them a little to where if they cut you 25 percent again you won't be crippled for another year? It may be a wise way to do it, I don't know.

Mr. BOWLES. If I could answer that, sir. Our budget request for fiscal year 1991, to handle the increased activity in that year was $4.5 million. That was what was authorized by the Administration and that was also authorized by this committee, generally because everybody thought that that's about the level of funds that would be needed to handle that industry. It was the Appropriations Committee that then subsequently cut us.

So the 6 percent increase that we are talking about is based on what was authorized.

Mr. HALL. So you played it straight with them last year and you got hurt, and you are going to lead them a little this time and play the game with them.

Mr. BOWLES. Well, we really are very significantly impaired as a result of this. This would have kept us on track and would restore the basic capability to handle an industry that is even greater than it was in 1990.

USER FEES

Mr. HALL. Let me get on to your announced plans to assess user fees for issuing licenses to commercial launch vehicle companies.

Will the launch vehicle companies be able to pass these user fees on to their customers, or do you have such a competitive environment that they will have to eat these costs? What studies have you made on that and what are your conclusions?

Ms. LEE-MILLER. Our economic impact analysis did determine that the launch companies, in our view, could absorb the cost of the user fees at this time. If we're able to keep them at the level that they are at, essentially the cost we are looking at would range from $22,000 more or less for a Delta vehicle on up to $50,000 for a Titan. Of course, there is substantial difference in size of these vehicles.

I am very concerned that the user fee regime not become a market barrier for the companies and not impede their competitiveness. At the level that we're at now, it is really a very small fraction of the total cost in the bidding process of a launch vehicle, which can be up to $30 million or $40 million for a launch vehicle and going up from there in the marketplace depending on the kind of vehicle that you're talking about. So I think that amount, given the fact that there is an effort on the part of DOT and the Administration to begin to institute the user fee regime at this stage in the industry's development so it doesn't come later, if we can keep it at a reasonable level—and there has been some discussion even from the Hill here asking, well, couldn't OCST have full cost recovery using user fees. Now, if we start moving in that direction, they would really go up dramatically and I think that would be a very serious blow to the industry. But these costs reflect the costs of reviewing the license documents within the office. And it is our judgement that this is not an impediment at this time.

Mr. HALL. So you say they could absorb and it would be your hope that they would absorb them.

Ms. LEE-MILLER. Well, they are certainly not going to be happy about it. No businessman is thrilled to have a fee assessed. But recognizing that, we feel that given the amount of dollars involved per launch that, yes, these fees are——

Mr. HALL. Actually, doesn't the United States Government buy most of the commercial launches that are being conducted these days?

Ms. LEE-MILLER. Not entirely. There are foreign customers that the companies have. Yes, the U.S. Government is a significant purchaser.

Mr. HALL. Like what percent?

Mr. BOWLES. About 30 percent of the manifest represent U.S. Government at this time.

Mr. HALL. Thirty percent. That's NASA, Defense Department, and all the other Government customers that launch vehicles?

Mr. BOWLES. That 30 percent would be if you took the 30 launches, those exclude the NASA launches, about 9 of the remaining launches of the 30 are Navy and SDIO.

Ms. LEE-MILLER. The balance is private. I'm concerned that the fact——

Mr. HALL. I'm concerned that we'd wind up covering most of the user fees. What are your feelings on that?

Ms. LEE-MILLER. I think that if the Government, and it is, is the largest purchaser of commercial launch services, we create an incentive for the companies not to provide commercial launch services if they are able to avoid the user fee because they have a Government payload as a customer.

Mr. HALL. I'm just wondering out loud if it makes sense to transfer money between Government agencies like that. It costs to handle it.

What would be your idea of the creation of some type of a trust fund to collect these user fees and use them for some worthy purpose that might benefit the industry?

Ms. LEE-MILLER. I was just admonished by my legal counsel that we're in the comment period of our regulations and so I am supposed to be careful in discussing——

Mr. HALL. Okay, I don't want to get any of us in trouble.

The next time I'm Chairman of this committee will be my second time, so I don't want to lead you into error.

Ms. LEE-MILLER. Oh, yes, Mr. Chairman, the issue of the trust fund is one that the companies are very interested in seeing happen because they are interested in improving infrastructure. However, given the level of user fees that we are instituting here, there won't be sufficient funds collected any time in the near future to make a substantial contribution to any infrastructure development or anything else. But certainly the idea of beginning that is something that we've been discussing with your staff.

LICENSING OF NASA LAUNCHES

Mr. HALL. NASA opposes your office issuing licenses, do they not, for launches of NASA payloads?

Ms. LEE-MILLER. NASA opposes it?

Mr. HALL. They've not supported what you're suggesting.

Ms. LEE-MILLER. No, they have not.

Mr. HALL. Do you know why?

Ms. LEE-MILLER. Well, frankly, Mr. Chairman, change is difficult. Government agencies—and I'm certainly not telling you anything you don't know far better than I—but this whole issue of commercial space transportation means that you now have the private sector coming in in a new way. They are not just contractors any more, working at the direction of the Government agency, being told which reports to file. They are providing a transportation service. Now I am at the Transportation Agency and, of course, we've got planes and trains that do this all the time, there is nothing unique and special about a company providing a transportation service.

However, in the space industry it is unique and special. The agencies that have been conducting and controlling their own launches relinquish this authority reluctantly and slowly. And I think we're really at a crossroads of making a judgement of which way we want to go. We will either have the commercial launch providers providing a transportation service, taking freight from point A to point B, taking a satellite, delivering it on orbit—which they have demonstrated they can do time and time again very efficiently, very reliably—or we have the Government agency insisting that it must do it. There is an example that I can give you. One of the launches that was a commercial launch, called the Mars Observer, conducted by Titan, has now been transferred back to a Government controlled launch. Well, the rationale that the agency must direct and control the launch falls short because in this case NASA has never launched a Titan, so there is no track record of experience here. Martin Marietta, on the other hand, has launched a number of Titans.

So, in my judgement, I really feel that we're advocating change here and we're trying to create a new capability in America. And that doesn't come easy and it does call for some tough calls. It cer-

tainly hasn't been pleasant for me to be a participant in a contentious inter-agency exercise which this has been. But I do think that the committee's intent in establishing the Office of Commercial Space, establishing the Commercial Space Launch Act, Title II, which your committee just put on the books just a few months ago, is exactly the right way to go. I urge the committee to continue moving down that path. In the long-run, I think that your judgement and the way that you are going is a positive contribution.

Mr. HALL. It would be my guess that you're not going to back off from change or any challenge. Very capable and efficient testimony that you've given today, and the good answers you've given to us to some tough questions indicates that you know what you're doing. We sure do thank you.

I know what I'm doing, too, because I have just been handed a note saying all other members have left. We can be thankful for a lot of things, the members are gone but the committee staffers are still here. They leave when the television goes a lot of times.

Ms. LEE-MILLER. Mr. Chairman, can I make one other comment.

Mr. HALL. You surely may say anything you want to say.

Ms. LEE-MILLER. You were beginning to talk a bit about some questions and concerns you have about how the user fee program might work vis a vis Government payloads and all that. I really hope that your staff will send us some written comments that can be included in our process. While I'm somewhat restrained from engaging in a full discussion now, I certainly would appreciate your thoughts as how we proceed in this area because there may be something that we need to take into consideration we haven't at this point.

Mr. HALL. Give us a call any time. We thank you for your testimony. Mr. Bowles, we thank you and for your backup. We thank all of you for the time you put in to the presentation and for the time you've given us here on the Hill.

We are adjourned.

[Whereupon, at 4:32 p.m., the committee adjourned, to reconvene at the call of the Chair.]

1992 NASA AUTHORIZATION

TUESDAY, MARCH 12, 1991

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON SPACE,
Washington, DC.

The subcommittee met, pursuant to notice, at 1:15 p.m., in Room 2325, Rayburn House Office Building, Hon. Ralph M. Hall [chairman of the subcommittee] presiding.

Mr. HALL. We will come to order.

As I think you can tell by the lights on the clock, we just finished with a vote, and some of the members will be a little delayed in getting here. The main ones are here now. [Laughter.]

We do welcome you here today, and today the subcommittee has set aside a special hearing to receive testimony from the outside witnesses. This has been a very important part of our process in the past, and it will be, I think, very valuable to us this year, for which we thank you.

In view of the recommendations of the Augustine report, one of our really highest priorities has been to try and identify a consensus on our space goals. We've heard from Admiral Truly from NASA, Bill Lenoir, Jim Rose at DOT, and we've had a hearing on the Augustine report.

We'll face some very difficult and tough choices this year as we work toward that consensus. What should be NASA's highest priority and what should be the true rationale for the Space Program? What should be the role of the new launch system? How can NASA maintain a balanced and robust Science Program? Are we headed in the right direction with the Space Station? Is the Moon/Mars Program practical and a worthwhile long term goal?

The witnesses we've invited today represent a wide spectrum of interests, and I'm certain that we'll hear some differences as well as some common points of agreement, and we certainly will listen to all of those and try to put everything into the computer and then come out with what answers the greatest good for the greatest number.

Ultimately, the subcommittee will need to put together a bill that best serves the common good and the public interest, and even though this has been difficult under the best of circumstances, it's going to be difficult again this year for a lot of reasons known completely to you all because you see it on the television and you hear it all the time—budgetary constraints and how to remold the future in space that's so important to all of us.

Your testimony is going to be a very great value to us in making this compromise, and I certainly look forward to hearing your testimony. I also look forward to hearing from Mr. Sensenbrenner, the subcommittee ranking Republican, for any comments that he might have, and usually his comments are very worthwhile.

[The prepared opening statement of Mr. Hall follows:]

OPENING STATEMENT

BY

Ralph Hall

Welcome. Today the Subcommittee has set aside a special hearing to receive testimony from outside witnesses. This has been a very important part of our process in the past and it will be especially valuable this year. In view of the recommendations of the Augustine report, one of our highest priorities has been to try and identify a consensus on our space goals.

We will face some very difficult and complex choices this year as we work toward that consensus.

--What should be NASA's highest priority and what should be the true rationale for the space program?

--What should be the role of the New Launch System?

--How can NASA maintain a balanced and robust science program?

--Are we headed in the right direction with the Space Station?

--Is the Moon/Mars program practical and a worthwhile long term goal?

The witnesses we have invited today represent a wide spectrum of interests and I am certain that we will hear some differences as well as common points of agreement. Ultimately the Subcommittee will need to put together a bill that best serves the common good and the public

interest. This has been difficult even under the best of circumstances and this year will be no different. Your testimony will be of great value to us in forging this compromise. I look forward to your testimony.

I would now like to turn to Mr. Sensenbrenner, the Subcommittee Ranking Republican, for any comments he might have.

Mr. SENSENBRENNER. Thank you very much, Mr. Chairman.

I have an opening statement that I'd like to ask unanimous consent to be placed in the record at this point, and——

Mr. HALL. I'd like to hear the statement first before I can rule on it. [Laughter.]

Mr. SENSENBRENNER. Okay. Well, you can read it while I state something extemporaneously.

Mr. HALL. Without objection.

[The prepared opening statement of Mr. Sensenbrenner follows:]

OPENING STATEMENT
By Hon. F. James Sensenbrenner
FY92 NASA BUDGET HEARING
Outside Organizations
March 12, 1991

GOOD AFTERNOON, MR. CHAIRMAN, AND MEMBERS OF OUR TWO PANELS. AS THE SUBCOMMITTEE CONSIDERS THE NASA BUDGET FOR FY92 AND BEYOND, WE CONTINUE TO BE IMPRESSED BY THE CARE TAKEN BY EACH OF YOUR ORGANIZATIONS IN ARRIVING AT THEIR POINT OF VIEW ON THIS BUDGET.

WITH A SUBJECT MATTER LITERALLY AS WIDE AS THE HORIZON, WITH ENDLESS OPPORTUNITY TO EXPLORE ON THE ONE HAND, AND LIMITLESS OPPORTUNITY TO LEARN ABOUT OURSELVES ON THE OTHER, THERE IS BOUND TO BE ROOM FOR DISAGREEMENT AMONG THOSE MOST KEENLY AWARE OF OUR NATION'S SPACE PROGRAM.

IN THE TRADITION THAT GOVERNMENT MUST ONLY DO WHAT PEOPLE CANNOT DO FOR THEMSELVES, AMERICA'S SPACE PROGRAM MUST ONLY DO WHAT CANNOT BE DONE FROM EARTH. AND WHATEVER WE DO MUST BE DONE WISELY AND IN KEEPING WITH OUR TAXPAYER RESOURCES. YOUR VIEWS, WHILE ENLIGHTENED BY YOUR RESPECTIVE FIELDS OF WORK AND RESEARCH, DO PROVIDE THE SUBCOMMITTEE INVALUABLE ASSISTANCE IN DISCOVERING WHAT CAN BE DONE FROM EARTH, AND WHAT MUST BE DONE FROM SPACE.

WITH THAT, MR. CHAIRMAN, I LOOK FORWARD TO TODAY'S PANELISTS.

Mr. HALL. Would you yield to me to ask unanimous consent for media coverage?

Mr. SENSENBRENNER. I ask unanimous consent for media coverage of this hearing.

Mr. HALL. Is there objection?

[No response.]

Mr. HALL. The Chair hears none. It's so ordered.

The Chair recognizes the gentleman.

Mr. SENSENBRENNER. When I started out in this business, I was frequently told that watching legislation being produced is like watching sausage being made. It is a very unappetizing process, but usually the result is quite pleasing to the palate in the end.

After hearing the Chairman's comments about putting everything into the computer and coming out with something that is mutually pleasing and beneficial, not only to those who are in this room and testifying today but also to the country and the world at large, I think that the computer does things a little bit more cleanly than the way Congress does it, and I would rather use the analogy of the sausage manufacture than the computer works, but we do have some rather large issues before us.

We don't have enough money to take care of everything that has been proposed either by NASA or by our friends outside the Government. Obviously, this committee has got a huge job to try to set priorities consistent with those budget restraints that will end up giving the American taxpayer the most bang for the buck as well as providing direction for our Space Program from now literally through the next 15 to 20 years.

So the testimony that we are going to be receiving today is most timely and most useful. I know I say that to most of the witnesses that come before the committee, but I mean it this time. Thank you very much.

Mr. HALL. Thank you, Mr. Sensenbrenner.

The Chair recognizes Mr. Cramer for any opening statement he may make.

Mr. CRAMER. I have no opening statement, Mr. Chairman.

Mr. HALL. Mr. Zimmer.

Mr. ZIMMER. I have no opening statement.

Mr. HALL. All right. Good. We'll get right down to work. We'll start the computer to run right here and now.

Mr. HALL. We have a very interesting witness list: Ms. Lori Garver of the National Space Society; Dr. Frank Eden of the American Geophysical Union; Dr. Steve Flajser and Jerry Grey of the American Institute of Aeronautics and Astronautics; and at this time, we'll lead off with—is it ladies first? Is that the way we operate?

The Chair recognizes Ms. Garver or however you all have arranged it, whoever wants to take the lead.

STATEMENT OF LORI GARVER, EXECUTIVE DIRECTOR, NATIONAL SPACE SOCIETY, WASHINGTON, DC

Ms. GARVER. Thank you, Mr. Chairman.

I'm here today representing the National Space Society. We're America's oldest pro-space public interest group, so when you say

you're representing the public interest, we're one of those groups. We were formed by the merger of the National Space Institute, which was founded by Wernher von Braun, and the L5 Society. We have 30,000 members and 120 chapters across the country dedicated to our overall goal of creating a spacefaring civilization. This goal and the fact that we are a public group will shape my overall remarks today because it is what drives our public policy positions as well as the specific programs that we support.

I have submitted several pages of written remarks that have been prepared by our Legislative Committee. I would like to spend my short time with you this afternoon to highlight some of the main points and go over the results of our membership survey, which is the Space Policy Survey done every spring.

Mr. HALL. If you would summarize, and we will without objection introduce and spread across the record your entire statement.

Ms. GARVER. Thank you, Mr. Chairman.

Mr. HALL. And we thank you. Proceed.

Ms. GARVER. In order to create a spacefaring civilization, which is the broad goal of our society, space travel must be routine and affordable. We evaluate each aspect of the Space Program with this in mind, which does sometimes lead us to different conclusions than those in other parts of the space community.

Our members' support of the Space Program goes beyond professional interests. They are members of the general public who do not have proprietary interests, a voice which we believe is not often enough heard in the Space Program.

When asked in our most recent Space Policy Survey, answered by more than 4,000 of our members, what was the most important rationale for going into space, the overwhelming response was to expand human presence into space. Now, this does fly in the face to some extent of the recommendations of the Augustine Committee, which said science was the overall purpose. That was the number two response, the number three response being for technology development.

Other answers include importance of the commercial development of space to foster international relations and to help monitor Earth's environment. It's not to say that these reasons are not important; however, we just don't believe they are the overriding purpose of the Space Program. We don't believe science ever was the overriding purpose nor should it be. We believe it is the expansion of humans into space.

The expansion of humanity into outer space is a goal that we share with the U.S. Congress, as outlined and endorsed by the Space Settlement Act of 1988, which was sponsored by Chairman Brown. And by the way, as we stated in our written testimony, one of the mandates of this report was that NASA report back to Congress every two years on the progress they're making in creating a spacefaring civilization, and we note that that report is overdue, and if any of you would be interested in checking when that could be available.

Two of the most critical elements in our overall policy objectives are a reduction in the cost of reaching space and the development of a knowledge base of how to live there and to utilize the resources there, again, to reduce the long term cost. Our approach

supports the use of Government money and expertise, which does come primarily from NASA, to support the development of key enabling technologies and the initial exploration efforts, then allowing private enterprise and capital market forces to lower costs where the technology has already been proven and where markets exist.

We support the conclusions of the Augustine Committee that NASA's efforts should be focused on projects which only it can undertake, leaving more routine matters to other agencies or to the private sector. This approach leads us to several specific program recommendations.

First is the Space Station Freedom Program. While it's difficult for us to take specific questions about this station, as it is currently undergoing review, we have always endorsed life sciences as the primary goal for the Space Station, and so we agree with the Augustine recommendations to focus on life sciences research. We hope that materials processing as well as astronautical science can come along the way. Materials processing, in particular, may be available before permanent manned capability is achieved on the Space Station.

The space exploration initiative is another program perhaps we support the strongest of anything else. We agree, again, with the Augustine Committee and with current planning that the moon should be the first priority over Mars. However, we disagree in focus with the Augustine Committee in that they feel the moon should only be used for a stepping stone to Mars, and we feel that the moon has other things to offer, including potentially the development of lunar resources and activities in sys-lunar space as a source of materials and possibly energy. In the long term, space-derived energy is likely to play a major part in Earth's economy, replacing scarce and environmentally destructive fuels.

In another survey asking our members what should be the focus, over three quarters supported a moon base before even going to Mars. Because of its importance, we disagree with the Augustine Committee that this should be done on a go-as-you-pay basis. We take note of the current budgetary constraints, and we don't feel that this will ever happen if it's on a go-as-you-pay basis. And in fact, more than 80 percent of our members on our survey responded that it should have equal or greater priority with other parts of the Space Program. Only 15 percent of our members supported the go-as-you-pay basis for SEI.

Another important program is Mission to Planet Earth, and NSS strongly supports this vitally important program of Earth observation. In a question of limited resources, we asked members on our survey if they would support Mission to Planet Earth or SEI, and it was about half and half. And given, I think, this would be the closest vote ever taken, since most people would prefer Mission to Planet Earth, I was quite surprised that our members support it that strongly.

However, we do have a number of concerns about the existing plans for carrying out Mission to Planet Earth. One, that NASA will be too involved in the operational aspect. As we previously discussed, we believe NASA should focus on what it does best, and that is being a cutting edge research and development and explora-

tion agency, leaving the operation possibly to NOAA or to the private sector.

Secondly, we believe that Mission to Planet Earth should take advantage of commercially available technologies and suppliers whenever possible. We believe that the development of a viable commercial remote-sensing industry is an important priority for the United States, and it is vital that Mission to Planet Earth be structured in a way that supports this industry rather than in a way that could possibly even harm it.

Space science and robotic exploration are strong priorities for NSS, as evidenced in the work we did this last year on the Ulysses mission. We were the public group that was out there filing agreements in the court to support NASA's launch of that mission. We were out on the causeway at NASA doing a counter-demonstration in order to show the protestors down there that the public didn't just feel that this mission should not go forward.

We believe, however, that the purpose of robotic probes is primarily as precursors for later activities that will be conducted by humans. The two are seen by us as interrelated and not either/or. The healthy increase for space science in this year's budget, including increased funding for CRAF/Cassini in particular, should be supported.

Finally, technology development. As mentioned earlier, this should be one of NASA's most important priorities. It is what they do best. Lowering space transportation costs, in particular, is of importance to us, including the investment in breakthrough technologies that can produce dramatic reductions in the cost of getting into space, and although we believe that market forces can substantially lower costs of technologies that have already been proven, the long term payoffs involved in new technologies mean commercial entities will not invest in the kind of research needed to create entirely new approaches. This is the classic reason for Government-conducted basic research and one that we believe applies with particular force in the space context.

There are two other issues on our survey which are of interest to your committee. One is of international cooperation in the Space Program. We asked our members which, if any, of the countries they would like to cooperate with on SEI, and about a quarter of them felt with Europe and with Canada; interestingly enough, the Soviet Union got more members wanting to cooperate with it than Japan. I think what this says about our membership is the fact that we believe space is a competitive marketplace, and we need to be structured in order to take on that competition. Interesting also was the fact that less than 1 percent believed we should go SEI alone.

NSS members also support the development of several legislative efforts which your subcommittee has been involved in to support commercial space development. Three quarters of our members believe that this is equally as an important agenda for our society as is the space station and is SEI. They're also willing to put their money where their mouths are. Sixty-five percent of them believe that these incentives should be taxpayer funded to help develop the commercial industry.

The final survey question we asked allowed our members to take the seats of some of you all and that they were given $100 and 10 NASA programs to fund. This was also the same question that was asked last year, and the comparative results between the two years is interesting. The first program, which last year was Space Station Freedom, has now dropped to number two, and a moon base is the primary issue for our members to spend money on. Second was the Space Station Freedom, and third was Mission to Planet Earth, which also gained in our results from last year. The final programs in order of importance were the Advanced Launch Development Program, Mars Exploration, NASP, Automated Robotic Missions, Space Commercialization, Solar Power Satellites, and SETI. In conclusion, the emergence of humanity into outer space represents a real qualitative change in human existence unlike anything that has come before. It is our duty to future generations to help this process along by making sure that our Nation's activities in space make the greatest possible contribution to this effort. This is our goal, and your subcommittee has helped us immeasurably in the past through things like the Space Settlement Act and the omnibus commercial space bill, which started to be produced last year, and the Space Service Purchase Act, and we hope that your help will continue.

Thank you, and I'll look forward to any questions you may have.

[The prepared statement of Ms. Garver follows:]

NATIONAL SPACE SOCIETY

PREPARED TESTIMONY OF LORI GARVER

EXECUTIVE DIRECTOR, NATIONAL SPACE SOCIETY

Mr. Chairman, members of the Subcommittee:

I appreciate the opportunity to appear before you today to discuss the pending NASA Authorization Act, and the future of our nation's space program. I speak on behalf of the National Space Society, America's oldest pro-space interest group. The National Space Society was formed by the merger of the National Space Institute, founded by Wernher von Braun, and the L5 Society. Made up of over 30,000 members and nearly 130 chapters, the NSS is a fast-growing group dedicated to the creation of a spacefaring civilization.

Creation of a Spacefaring Civilization

By "a spacefaring civilization," we mean a civilization in which space travel is routine and affordable, and in which permanent human settlement exists beyond the earth's surface. We believe that the expansion of humanity into outer space is our species' manifest destiny, and that America -- as a nation with a proud frontier history -- has a premier role to play in fulfilling that destiny. This is a view that has been explicitly endorsed by the Congress in the Space Settlements Act of 1988, a bill sponsored by Representative (now Chairman) George Brown.[1]

[1] Included in S. 2209, 100th Cong., 2d Sess., signed Nov. 17, 1988. This Act explicitly endorsed the goal of "extension of life beyond Earth's atmosphere, leading ultimately to the establishment of space settlements," and provided for biannual reports by NASA regarding efforts it is undertaking to promote

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It was also endorsed by President Bush in his speech of July 20, 1989.

Though others have endorsed this goal, the creation of a spacefaring civilization is NSS's core purpose. For this reason, we evaluate each aspect of our space program in light of this overriding question: what contribution does this make to the creation of a spacefaring civilization? Though we strongly support our nation's space effort, asking this question sometimes leads us to different positions than those taken by others in the space community. Some examples of this follow.

Specific Issues

If we are to establish a spacefaring civilization, we must see the cost of reaching space, and of travelling through the solar system, decline dramatically. We must also develop a substantial base of knowledge: how to live in space for long periods, how to acquire and use nonterrestrial materials, and how to do so (again) at the lowest possible cost.

In accomplishing these goals, we favor an approach in which government money and expertise (mostly from NASA) are directed

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this goal.

We note that NASA's first report under the Act is now overdue, and encourage your Subcommittee to inquire as to when it may be expected.

toward the development of key enabling technologies and initial exploration efforts, while private capital and market forces are used as means of lowering costs in areas where the technology has been proven and markets exist.[2] We also believe, as the Augustine Committee recommended,[3] that NASA's efforts should be focused on projects that only it can undertake, leaving more routine matters to other agencies or the private sector. This approach leads to the following program-specific recommendations:

Space Station Freedom

In light of the ongoing redesign efforts, we can take no position on specific design questions. However, we believe that in general the most important mission for the space station is life sciences research -- that is, building up the necessary database on living in space to allow more ambitious long-term

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[2] This is an approach used with great success by NASA's predecessor, NACA, in promoting the commercial aircraft industry. See D. Mowery & N. Rosenberg, The Commercial Aircraft Industry, in Technology and the Pursuit of Economic Growth 169-202 (1989). It is also a technique that NASA is just beginning to apply in the space field, with its much-applauded COMET program. Where technologies have been proven, market forces are much better at lowering costs than government programs -- as demonstrated by the rapid decline in prices (and increase in capabilities) of computers, VCRs, and other similar goods once commercial markets for them opened up.

[3] For the complete NSS response to the Augustine Committee's recommendations, see NSS Position Paper, "Response of the National Space Society to the Recommendations of the Advisory Committee on the Future of the United States Space Program." Copies of this response have been furnished to the Subcommittee; interested parties may obtain their own copies of this and other NSS Position Papers by contacting David Brandt at NSS Headquarters, (202) 543-1900.

plans in the future. Other potential station missions deserve a lower priority. Microgravity research can be done on commercial experiment platforms (like COMET or various other commercial free-flyers), on Space Shuttle experiment pallets, or on free-flying platforms serviced from the station. And although the station may play a key role as a transportation node, that is an option that should be kept open for future developments, though we do not mean to discount the importance of this role.

In fact, in the early years of space station Freedom, it is likely that microgravity research will play the greatest role simply because of the capabilities available during the construction phase. This is because much of the vital life-sciences research that we favor will not be practicable until the station is permanently occupied by humans. During the early years, when the station is still only intermittently occupied, it is likely that microgravity research will be feasible to a greater extent than life sciences research, and thus will play a greater role. However, over the long term, we expect this ratio to reverse itself, in favor of the kinds of life sciences research needed to support long-term human presence in space.

Space Exploration Initiative

We strongly support President Bush's plans for human exploration throughout the solar system, particularly involving the Moon and Mars. We also agree with the Augustine Committee

that such exploration efforts should begin with a base on the Moon.[4] A lunar base will provide us with needed experience -- and useful lunar materials -- to support more ambitious plans later on.[5] It will also be available to support activities in cislunar space, as a source of materials, and perhaps even energy. Indeed, over the long term, space-derived energy -- whether from lunar Helium-3, or from space-based solar power stations -- is likely to play a major part in Earth's economy, replacing scarce and environmentally-destructive fossil fuels.[6] We disagree, however, with the Augustine Committee's recommendation that SEI efforts proceed slowly, on a "go as you pay" basis. We believe that a firm commitment, coupled with stable, long-term funding, is essential for the success of SEI, as for any high-technology program.

Mission to Earth

NSS strongly supports this vitally important program of Earth observation. We believe that a thorough understanding of Earth's climate and biosphere is essential to the preservation of environmental quality, and that this program provides a

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[4] See NSS Position Paper, "A Return to the Moon" (available from NSS Headquarters).

[5] See NSS Position Paper, "Nonterrestrial Materials: A Critical Resource" (available from NSS Headquarters).

[6] See NSS Position Paper, "Earth's Energy Future: Nuclear and Satellite Solar Power" (available from NSS Headquarters).

compelling demonstration of the ways in which space technology contributes to the improvement of life on the ground.[7] However, in line with the guidelines set out above, we have a number of concerns about existing plans.

First, we do not consider Mission to Earth to be "space exploration" at all. It is an enormously valuable environmental program, using technology developed by the space program. However, we do not consider it a core part of our space program itself: Mission to Earth looks inward, not outward. Obviously, because of the nature of the technology involved, Mission to Earth will require a great deal of participation by NASA, particularly in the research and development phase, where platforms and sensors are being designed. Once in operation, though, we believe that serious consideration should be given to having the system operated by some entity other than NASA: NOAA, for example, or even a private-sector entity.[8] Along with the

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[7] For more on this issue, and on the impact of space exploration and development on environmental issues generally, see Hartmann, Space Exploration and Environmental Issues, 6 Environmental Ethics 227 (1984).

[8] Obviously, the mistakes inherent in the bungled LANDSAT privatization must be avoided. However, we are not proposing the commercialization of Mission to Earth, merely private-sector operation, perhaps along the lines used for other projects such as the Jet Propulsion Laboratory. Also, we should stress that we are referring to the nuts-and-bolts operation of the system, not to the scientific investigations undertaken in using the system. Many of the principal investigators will no doubt remain within NASA. And that is entirely appropriate, as it is the kind of cutting-edge scientific work that NASA is best at. We recommend only that the aspects of Mission to Earth that

Augustine Committee, we believe that NASA should concentrate on what it does best: being a cutting-edge research, development, and exploration agency. By way of analogy, NASA does advanced communications satellite development work, but does not operate our nation's communications satellites. Given the size and duration of Mission to Earth, operational responsibilities could be a significant distraction for NASA.

Second, we believe that the organization of Mission to Earth should take advantage of commercially-available technologies and suppliers wherever possible. For example, a recent National Academy of Sciences report recommended that Mission to Earth be designed with an early stage using small satellites to get initial sensor packages up early.[9] Such satellites and sensors are likely to be procurable on short order from commercial concerns -- as NASA's own Goddard center demonstrated by arranging for the commercial purchase of space-gathered data for the Ocean Color Data Set (formerly SEAWIFS) portion of Mission to Earth.

Likewise, we believe that Mission to Earth's government-

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are not cutting-edge science -- basic operational matters -- might be better placed elsewhere.

[9] We understand that this is not feasible in all cases, since many data sets must be gathered contemporaneously to be useful. But this concern does not apply to all aspects of Mission to Earth.

operated segments should be designed so as not to compete unnecessarily with commercial enterprises. The development of a viable commercial remote-sensing industry is an important priority for the United States, and it is vital that Mission to Earth be structured in a way that supports this industry, rather than in a way that will harm it. Foreign concerns -- from the French SPOT to the Soviet Soyuzkarta -- are already seizing a large share of the commercial remote sensing market. American firms will have enough difficulty competing with these enterprises without having to deal with U.S. government policies that make their position more difficult. Wherever possible, Mission to Earth should be configured so as to give U.S. enterprises a boost, instead of tripping them up.

Space Science and Robotic Exploration

If Mission to Earth is not true space exploration, probes to other planets certainly are. NSS strongly supports robotic exploration missions, as evidenced by our efforts -- both in court and elsewhere -- on behalf of the Ulysses mission last year.[10] However, we do not believe that the most important role for automated exploration is the gathering of pure scientific knowledge for its own sake. Rather, we believe that such probes

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[10] NSS filed comments in support of the Ulysses launch at the Environmental Impact Statement stage, and entered the actual litigation over the launch in the federal District Court as an amicus curiae ("friend of the court") in support of the mission. In addition, NSS members and officers across the nation spoke in favor of the launch.

have their chief value as precursors for later human activities. Just as the settlement of the American West was preceded by exploratory missions like those of Lewis & Clark or Zebulon Pike, so human settlement of space should be preceded by exploratory missions like those of Surveyor, Viking, and Voyager.

Only in this context does a truly major commitment to robotic planetary exploration make sense. Human exploration and robotic exploration must go hand-in-hand, notwithstanding the all-too-popular view that they should be thought of in either/or terms. In fact, "either/or" thinking on this topic is unlikely to help even the cause of robotic exploration: if human exploration and expansion are given a low priority, it then becomes more difficult to make a strong case for robotic missions either, given that other competitors for research dollars -- biomedical research, for example -- might then arguably have a stronger claim to improving the human condition than would the abstract knowledge generated by robotic planetary missions. The result would be a disaster for the space community as a whole, and for humanity. For this reason, we oppose treating robotic exploration as somehow separate from, and independent of, human exploration and settlement.

However, because of the way in which debate in this area sometimes seems polarized, it is worth stressing again what we are not saying: we are not saying that we should do less robotic

exploration so that we can do more human exploration. Rather, we are saying that the two should be seen as interrelated, and that the long-term economic payoffs of robotic exploration -- in terms of identifying resources, building knowledge bases, and locating likely destinations for future human exploration -- should be taken into account. In this regard, we would like to urge more robotic missions aimed at identifying resources in cislunar space, such as lunar observations and missions to Earth-crossing asteroids. Indeed, even very inexpensive programs, such as increased grants to terrestrial astronomers to search for and identify asteroids that come near to Earth, can bear enormous fruit over the long term.

Technology Development

As mentioned earlier, NSS believes that NASA has a very important role to play in the development of new technologies that will lower the cost, and increase the capabilities, of space activity. Lowering space transportation costs is a particularly important item, but other issues, such as life-support and on-orbit activities, are also important. We believe that NASA has a vital role to play in both near-term and long-term contexts, though the approach that should be taken differs according to the circumstance.

Near-term, NASA should emulate the role played by its predecessor, NACA, in the commercial aircraft field. As

suggested recently by the Commercial Space Transportation Advisory Committee (COMSTAC), this means developing (in close consultation with industry) key component technologies that will make commercial launch vehicles using existing chemical technology more reliable and less expensive -- analogous to the work done by NACA on low-drag engine cowling and high-efficiency engine placement designs in the 1920s and 1930s, work that made long-distance commercial aviation feasible. This kind of work will help lower the costs of space activity, giving both taxpayers and commercial customers more for their money. It will also help promote the competitiveness of the U.S. commercial launch industry, as it faces competition from a growing number of foreign concerns.[11]

Long-term efforts should focus on "breakthrough" technologies that can produce dramatic reductions in the cost of getting people and materiel into space. A recent Office of Technology Assessment report[12] identified several candidate technologies along these lines. Many consider laser launch systems and "mass driver" electromagnetic systems to be particularly worthy candidates, but there are many others, and all should be explored, at least for feasibility, at this early

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[11] See generally NSS Position Paper, "The Commercialization of Space" (available from NSS Headquarters).

[12] Office of Technology Assessment, Launch Options for the Future (1988).

stage.

Such advanced technology research has virtually ceased at NASA, as a result of short-term pressures. We agree with the Augustine Committee that this is a mistake, and that NASA needs some mechanism -- perhaps a fixed percentage of its budget devoted to long-term research -- to ensure that short-term concerns do not lead to the short-changing of research that could, if pursued, produce enormous payoffs over time. If we are to create a true spacefaring civilization, costs of reaching orbit and operating in cislunar space must be reduced by several drastically. It is simply impossible to do this merely by refining existing technology; new developments are required. Although NSS believes that market forces can substantially lower the costs of technologies that have been proven, the long payoff times involved for new technologies mean that commercial entities will not invest in the kind of research needed to create entirely new approaches. That is a classic reason for government-conducted basic research, and one that applies with particular force in the space context.

Conclusion

In the past, some have called for an overarching principle that would help bring order to the choices that must be made in structuring America's space program. We believe that our goal -- the creation of a spacefaring civilization -- is the answer to

that call. If space exploration were merely another scientific activity -- like high-energy physics or recombinant DNA -- then no such overarching goal would be needed. But space isn't just another scientific activity, and the country has always realized it. That is why space exploration has been placed within its own agency, NASA, instead of merely being placed under the jurisdiction of the National Science Foundation.

Our vision is of a spacefaring civilization. With humanity residing throughout the solar system, we will no longer be at risk of extinction because of a single event, whether it is a nuclear war, or a cometary impact like that thought to have wiped out the dinosaurs. With access to cheap solar energy and the material wealth of the solar system, many problems of scarcity and environmental degradation will be solved. And, in carrying out that expansion, we will be carrying on the frontier spirit that made America great.[13]

In the introduction to his award-winning history of the space age, historian Walter McDougall compares humankind's emergence into outer space to the emergence of the first

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[13] For more on this topic, see NSS Position Paper, "Settling Space: The Main Objective" (available from NSS Headquarters).

lungfish from the oceans.[14] Though dramatic, this comparison is not overdrawn. The emergence of humanity into outer space represents a real qualitative change in human existence, unlike anything that has come before. It is our duty to future generations to help this process along, by making sure that our nation's activities in space make the greatest possible contribution to the eventual spread of humanity beyond the Earth. This is NSS's goal; we hope that you will help.

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[14] W. McDougall, The Heavens and the Earth: A Political History of the Space Age (1985). See also G. Reynolds & R. Merges, Outer Space: Problems of Law & Policy 325 et seq. (1989).

National Space Society
. . .creating a spacefaring civilization

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Biography, 1991

Lori B. Garver

Lori Garver is Executive Director of the National Space Society, a public-interest space support organization. Founded in 1974, this 30,000 member organization manages conferences, tours, educational programs and publishes Ad Astra magazine.

Ms. Garver is a founder of Spacecause, a national lobbying group formed in 1987 to support the space program through grass-roots political support. She currently serves as a member of its Board of Directors.

Ms. Garver is co-chairman of the education committee for the International Astronautical Federation and is a member of the Board of Directors of Women in Aerospace.

Ms. Garver received her masters degree in Science, Technology and Public Policy from the George Washington University in 1989. She is an alumni of Colorado College where she holds a B.A. in political science and economics.

Previous to joining the National Space Society in 1984, Lori worked on a number of political campaigns including the John Glenn Presidential Campaign.

Ms. Garver resides on Capitol Hill with her husband, David Brandt.

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BACKGROUND INFORMATION

NATIONAL SPACE SOCIETY

Results of 1991 Space Policy Survey
(results from sample of 3,000 member responses)

1. Which rationale would you single out as the most important reason to explore space?

40% expanding human presence in space
27% scientific knowledge
18% technology development
7% learning how to improve Earth's environment
6% commercial potential
1% fostering international cooperation
1% positive impact on math and science education

2. The budget for Space Station Freedom is to be cut over the next five years. Rank the importance of the following:

42% life sciences
31% materials research
27% astronomical sciences

3. The Augustine Committee recommends that the Space Exploration Initiative (SEI) take a back seat to other space programs, as funding is too tight to do it all now. Do you think that:

46% SEI should be pursued equally with other programs
39% SEI deserves the greatest priority
15% Funding is too tight and SEI should take a back seat

4. One way to reduce the projected costs of SEI is to narrow its scope now. If this becomes necessary, should SEI:

77% focus on permanent settlement on the Moon
23% focus on Mars exploration

5. In pursuing SEI, which of the following partners, if any, should the U.S. approach about becoming major participants?

27% European nations
26% Canada
23% USSR
23% Japan
1% None, SEI should be an exclusively U.S. initiative

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6. As a part of SEI, should the study of near-Earth asteroids (both to search for potential resources and to determine the threat of collisions with Earth) be:

74% a long-term objective, only after the Moon and Mars
26% a near-term objective, delaying Moon and Mars

7. What should NSS policy be toward the next review of the Moon Treaty (in 1994)?

69% support amendment to protect private enterprise rights
20% oppose Moon Treaty as written
11% support Moon Treaty as written

8. If it becomes impossible to fund both SEI and Mission to Planet Earth, which program should take priority?

51% Mission to Planet Earth
49% Space Exploration Initiative

9. Do you believe that taxpayer money should be used to provide incentives for companies that are trying to get started in space commerce?

65% Yes
35% No

10. Should NSS support for legislative actions such as the "Omnibus Space Commercialization Act" be a top priority for the Society?

75% Yes - along with SEI and Space Station
25% No - NSS needs to focus its efforts on SEI and Space Station

11. If you had $100 to allocate to the following NASA programs, how would you divide it up? (Comparison to 1990 survey)

$16 for Moon Base ($18)
$16 for Space Station Freedom ($19)
$12 for Mission to Planet Earth ($11)
$11 for Advanced Launch Systems ($9)
$10 for Mars Exploration ($11)
$ 9 for National Aerospace Plane (NASP) ($10)
$ 8 for Automated Science Missions ($7)
$ 7 for Support of Space Commercialization ($7)
$ 7 for Solar Power Satellites ($5)
$ 4 for Search for Extraterrestrial Intelligence (SETI) ($3)

Mr. HALL. Thank you, Ms. Garver, and we will have some questions for you, but we'll save the questions until everyone has had a chance to testify. In the meantime, I think Mr. Bacchus has arrived.

Do you have any opening statement or anything you'd like to say, Mr. Bacchus? The Chair recognizes you at this time.

Mr. BACCHUS. Thank you, Mr. Chairman.

I will reserve my opportunity to ask questions. I merely wanted to applaud Ms. Garver and her society, of which I have been a member, and merely say that with her I think I believe that while the earth is the cradle of mankind, mankind will not always remain in the cradle.

Thank you, Mr. Chairman.

Mr. HALL. And I'll be figuring that one out while the next——

[Laughter.]

Mr. HALL. We have the very distinguished member from California, Mr. Rohrabacher.

I recognize you at this time. Don't confuse me, though, like Mr. Bacchus did.

Mr. ROHRABACHER. Well, I just would like to say that I'm on two subcommittees that are meeting at exactly the same time, and I would like to apologize for not being here to hear all of the testimony from these different groups, but it's so vital that we have input from not just Governmental organizations and interest groups but from citizens who are very concerned about space and about America's leading technology in the future, and so I consider this to be vital testimony, and I'm sorry I won't be here much of the time, but I'm a big supporter of the National Aerospace Plane, which is down the hall, and I will be reading the testimony which I'm not here to listen to, and thank you very much, Mr. Chairman.

Mr. HALL. Thank you, and I think that emphasizes the fact that we're all on about five different subcommittees, and we sometimes get those set at the same time, but we have staff at all of the subcommittees, so your voices are not falling on ears that won't relate it to the members of Congress, and that's the important thing.

Mr. HALL. The Chair recognizes Dr. Eden.

STATEMENT OF DR. H. FRANK EDEN, CHAIRMAN, AMERICAN GEOPHYSICAL UNION BUDGET PANEL

Dr. EDEN. Thank you, Mr. Chairman.

I, too, have a short oral statement which is somewhat amplified in written testimony which is being submitted for the record.

Mr. HALL. Well, for each of you, if you have written testimony, please submit it. It will be made part of the record if no one objects. No one objects, and you might summarize, and it would allow us more time to really lock horns with you on question and answers. Thank you.

Dr. EDEN. Mr. Chairman and members of the subcommittee, thank you for inviting the American Geophysical Union—the AGU—to testify on the NASA fiscal year 1992 budget request. The AGU is a scientific society with a membership of some 27,000 professional scientists who are involved in all aspects of space science and, in particular, in the study of Earth.

First of all, it is AGU's position that NASA's program to study Earth is critical to obtaining a necessary understanding of our home planet. We endorse the President's proposal to increase the budget for NASA in fiscal year 1992. How best to use these funds was addressed in the report of the advisory committee on the future of the U.S. Space Program, the Augustine Committee, which made a number of significant recommendations designed to improve and clarify the total NASA program.

For example, the report stressed the need for a strong space science program at the highest priority to act as the fulcrum for the entire civil space science effort and to balance the two mission-oriented undertakings of Mission to and from Planet Earth. AGU supports both the need for this study and its recommendations relative to the study of Earth. We urge that the Augustine plan be used as a blueprint in consideration of NASA's budget, since it has a broad consensus of support in the science and engineering communities.

To determine whether the proposed NASA program for fiscal year 1992 meets the Augustine plan, the funding for space science, Mission to Planet Earth and Mission from Planet Earth should be identifiable as separate elements in the NASA budget. The fact that this is not easily done in the fiscal year 1992 budget gives rise to some confusion and may even undermine the value and intent of the Augustine report in the future. In particular, the present budget structure can lead to very large Mission to and from Planet Earth Programs, impacting the basic Space Science Program. Because the distinctions between these three programs are not clearly spelled out in this budget, there has been a confusion leading to different analyses.

One analysis is that the space science effort would be 23 percent of the total NASA budget when, if the Augustine criteria are applied, it's more like 16 percent of the total budget. While these differences may seem to be quibbling and the difference between 16 percent and the nominal 20 percent figure endorsed by the Augustine Committee may seem small, every 1 percent of difference is equivalent to about $150 million. For example, that's certainly sufficient so that the orbiting science laboratory, which was the next new start in the OSSA strategic plan, could have been funded in this year's budget, as could have significant additional data analysis, basic research, and possibly small missions.

It should be noted that the OSSA's—the Office of Space Science and Applications—strategic plan was endorsed in the Augustine report. Clearly, a budget process that separates space science funding from Mission to and from Planet Earth is required if the Augustine report is to prove viable.

Another specific comment relates to the question of balance in the Earth sciences budget. When the cost of EOS and the earth probe projects are transferred to Mission to Planet Earth, as recommended in the Augustine Committee report, the Earth science budget drops by approximately $50 million from fiscal year 1991 to fiscal year 1992. This reduction seems particularly inappropriate in light of the Nation's many concerns with issues such as climate change, earthquakes, water availability, air and water quality, and resource availability.

Last year there was a similar reduction in funding proposed for the basic Earth Science Research Program, and Congress saw fit to correct the problem by transferring funds into this program for interdisciplinary studies and basic research. In accordance with the Augustine report, the American Geophysical Union believes that a space science program that includes Earth science warrants the highest priority in NASA and should grow with the agency.

Moving now to Mission to Planet Earth, the American Geophysical Union strongly supports the goal of this program to study Earth as a planet by using observations from space. There needs, however, to be a clear definition of the scientific scope of this program. The American Geophysical Union considers it essential that the scope be that described in the original Mission to Planet Earth report that was issued by the National Academy of Sciences in 1988 and which is entitled "Space Science in the 21st Century."

In that report, the mission scope spanned the total Earth system, from the core to the land to the oceans to the atmosphere to the space environment. It would be a serious mistake if NASA's program was constrained to only global change, which currently is focused on the single question of climate change. There are other important aspects of the Earth's system that affect life on our planet and that must be measured and understood.

As to Mission from Planet Earth, we look forward to a description of this program. For the program's proposed first step, Space Station Freedom, we are unable to provide a justification related to understanding Earth in our areas of expertise. A clear justification for Space Station Freedom is, of course, required.

Again, let me thank you, Mr. Chairman and members, for inviting the American Geophysical Union to contribute our views to your deliberations, and I'd be happy to respond to any questions you may have either now or later.

[The prepared statement of Dr. Eden follows:]

Committee on Science, Space, and Technology
Subcommittee on Space
U.S. House of Representatives

Hearing: March 12, 1991

Testimony of H. Frank Eden, for the American Geophysical Union

Mr. Chairman and members of the subcommittee. Thank you for inviting the American Geophysical Union, AGU, to testify on the NASA FY 1992 budget request. My name is Frank Eden and I am the Chairman of both the AGU Budget Panel and Global Change Panel. The AGU is a scientific society with a membership of some 27,000 professional scientists who are involved in all aspects of space science and in particular the study of Earth.

First of all, it is AGU's position that NASA's program to study Earth is critical to obtaining the necessary understanding of our home planet. We endorse the President's proposal to increase the budget for NASA in FY 1992. How to best use these funds was addressed in the report of the Advisory Committee on the Future of the U.S. Space Program, the Augustine Committee. It made a number of significant recommendations designed to improve and clarify the total NASA program. AGU supports both the need for this study and its recommendations relative to the study of Earth. We urge that the Augustine plan be used as a blueprint in considerations of the NASA budget since it's the one plan that has a broad consensus of support in the science and engineering communities.

To determine whether the proposed NASA program for FY 1992 meets the Augustine plan, the funding for Space Science, Mission to Planet Earth, and Mission from Planet Earth should be identifiable as separable elements in the NASA budget. The fact that this is not done in the FY 1992 budget gives rise to confusion and may undermine the value and intent of the Augustine report in the future. In particular, the present budget structure can lead to the very large Mission to and from Planet Earth programs cutting into the basic Space Science program. Because the distinctions between these three programs are not clearly spelled out in this budget, there has been confusion leading to differing analyses. One analysis gives the Space Science effort to be 23% of the NASA budget when if the Augustine criteria are applied, it is only 16% of NASA's total budget. While the differences between the actual Space Science percent and the nominal 20% figure advocated by the Augustine Committee may seem small, every 1% of difference is equivalent to about $100M in programs. For example, the shortfall is certainly enough so that the Orbiting Solar Laboratory, which was the next new start in the OSSA strategic plan, could have been funded in this year's budget, as could significant additional data analysis, basic research, and numbers of small missions. It should be noted that the OSSA strategic plan was endorsed in the Augustine report. Clearly, a budgeting process that separates Space Science funding from Mission to and from Planet Earth funding is required if the Augustine plan is to prove viable.

Another specific comment related to the question of balance is on the Earth science budget. When the costs of EOS and the Earth Probe projects are transferred to Mission to Planet Earth, as recommended in the Augustine report, the Earth science budget drops by approximately $50M from FY 1991 to FY 1992. This major reduction seems particularly inappropriate in light of the nation's many concerns with issues such as climate change, earthquakes, water availability, air and water quality, and resource availability. Last year there was a similar reduction in funding proposed for the basic Earth science research program and Congress saw fit to correct the problem by transferring funds into this program for interdisciplinary studies and basic research. In accord with the Augustine report, AGU believes that a Space Science program that includes Earth science warrants the highest priority in NASA and should grow with the Agency.

Moving now to Mission to Planet Earth, AGU strongly supports the goal of this program to study Earth as a planet by using observations from space. There needs, however, to be a clear definition of the scientific scope of this program. AGU considers it essential that the scope be that described in the original Mission to Planet Earth report. This was issued by the National Academy of Sciences in 1988 and was titled Space Science in the Twenty-First Century. In it the mission scope spanned the total Earth system from the core, to the land, oceans, atmosphere, to the space environment. It would be a serious mistake if NASA's program was constrained to only Global Change, which is now focused on the single question of climate change. There are other important aspects of the Earth system that affect life on our planet that must be measured and understood.

As to Mission from Planet Earth, we look forward to a description of this program. For the program's proposed first step, Space Station Freedom, we are unable to provide a justification related to understanding Earth. A clear justification for Space Station Freedom is, of course, required.

Again let me thank you for inviting AGU to contribute our views to your deliberations. I would be more than happy to respond to any questions you might have either now or later.

Biographical Sketch: H. Frank Eden

H. Frank Eden received his Ph.D in physics from the University of Newcastle, U.K. in 1959. He has been involved in the geosciences for over 30 years in positions that include Director of New Programs and Satellite Oceanography Programs at Joint Oceanographic Institutions Inc.; various positions at the National Science Foundation including Senior Science Associate in the Astronomical, Atmospheric, Earth and Ocean Science Directorate, and Head of the Atmospheric Research Section; as well as a detail with the Energy and Science Division of OMB. Prior to government services he was a member of the Senior Staff at Arthur D. Little, Inc., Research Associate in Geophysics at the Massachusetts Institute of Technology, and Senior Research Associate in Physics at the University of Newcastle, U.K.

He has served in a variety of assignments for several scientific societies including: Meetings Chairman for the American Geophysical Union; Chairman of the AGU Panel on Global Change which reviewed, at the request of the President's Science Advisor, the reports on *The U.S. Global Change Research Program* for FY 1990 and FY 1991; Chairman of the AGU Committee on Public Affairs, COPA, which is charged with ensuring that AGU's opinion and advice on geophysical issues are provided to Congress and the appropriate agencies; Chairman of the AGU Budget Panel; Member of the Intersociety Working Group for the AAAS Annual Reports on Budget for Research and Development, FYs 1988 through 1992; Chairman of the University Space Research Association's Advisory Committee for the Goddard Space Flight Center graduate student summer program; and Treasurer of Incorporated Research Institutions for Seismology, IRIS. He has published widely in the scientific literature devoted to geophysical studies.

Mr. HALL. Dr. Eden, thank you, and there will be questions. We next recognize Dr. Flajser.

STATEMENT OF DR. STEVEN H. FLAJSER, MEMBER, AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS POLICY COMMITTEE, WASHINGTON, D.C.

Dr. FLAJSER. Thank you, Mr. Chairman.

I'm here, along with Jerry Grey, representing the AIAA— American Institute for Aeronautics and Astronautics—and we comprise about 40,000 professionals in Government industry, academia, and elsewhere that cover a whole range of disciplines and interest areas, and as you will probably surmise if you looked at the written testimony, there's something in there for most of our individuals, and we are particularly encouraged with the NASA budget this year because it does show positive growth.

By way of setting the framework, I'd like to cover a few points in the testimony and submit, as you suggested, the written testimony for the record.

First off, it is important to note that we basically concur with the recommendations of the Augustine report, particularly with regard to budgets. We note that while they recommended a 10 percent real growth, the President's budget comes in a little bit more modestly at 8.5 percent, and even at 8.5 percent growth, we recognize that there are going to be strong pressures to reduce the deficit and therefore look for reductions in all agency budget requests, including NASA.

We're fearful of this and the members are fearful of this because often times this has the result of trading off long term benefits for short term budget relief. Nevertheless, that is the reality, and in that sense we offer three principles, if you will, that may be useful in this compromise situation that we are all facing.

Number one, that the space technology base receive support because it really is the seed core in the future for the Space Program. Number two, long term programs that evolve over a decade time framework should not be funded out of what might be viewed as the leftovers, the scraps on the table, but really given a consistent—if necessary, modest—funding over a period of time and not be constrained by a specific time table but just by guidance of the long term; for example, SEI. And third, on balance, if there is a tradeoff to be made with ongoing programs versus new programs, the feeling is that once the program has been approved by NASA, it should be implemented, it should be completed on schedule within budget, and if something that's in the cue is ready to be launched as a new initiative, it should perhaps be considered a little bit lower priority. It doesn't do anyone any good to stretch every single program and then have them all come in over cost and behind schedule.

Turning specifically to programs in the NASA budget, we first turn to the space science area, which is the highest priority by the Augustine Commission. On balance, we feel that OSSA—the Office of Space Science and Applications—is managing a very good program, they have a very flexible program plan, and it is worthy of the committee's support. There are a number of examples we cite

in there of various programs from Voyager 2 to Hubble and the astro missions that we think are positive in terms of their return.

We also cite some concerns that the scientific community, as represented by AIAA, has found. One is a perception that the quality—the excellence of science has been eroding. There is a concern that the big programs, the big science programs, tend to push aside some of the smaller science programs, and there's a feeling that more emphasis has to be given to the smaller missions. And third, going back to an earlier comment, that NASA should be accountable for an orderly completion of existing programs and program managers should be responsible in the organization for looking at the entire cost of the program, not just, let's say, the science cost, but also incorporating launch costs, operation costs, and data analysis costs.

We talk a little bit about some other programs that are worthy of support, such as AXAF, CRAF/Cassini, Mars Observer. We have a modest recommendation for augmentation in the area of astroid research. I think perhaps we'll not get into that but leave that for further discussion or analysis.

Another area that we consider part of the science area is the Mission to Planet Earth that's been discussed by others at the witness table today. We support the program, particularly the EOS-A initial portion. With regard to EOS-B, which we consider a long term project and will not become available until later in the decade, and with the current fiscal environment, perhaps it should be funded on sort of a level-of-effort basis as well. Finally with regard to Mission to Planet Earth, we encourage the Earth probes area of that program because these are the smaller missions that can be launched on an earlier time table that give you a quicker return in the science area.

The next point we wish to make is that the Office of Space Science and Applications—OSSA—has a letter in it, "A," which we feel is sometimes overlooked, particularly with regard to the Augustine Commission. We believe that they had it in there as the highest priority goal, science and applications, but we want to underscore that, and that is I think this committee historically has not allowed NASA to drop the "A," and we encourage you not to let NASA drop the "A" again. And there are some very clear examples of why this is important.

Perhaps of more historical value but also of future value is a program that this subcommittee and the Congress generally has supported for a number of years, and that's the ACTS Program—Advanced Communication Technology Satellite Program. That's a program that faced a great deal of difficulty in getting funding by the Administration over a period of years. Fortunately, that's behind us, the program is due to be launched in about a year and a half.

But one of the most interesting things about that program is that it is an example of how NASA can do R&D and prototypical technology development, and then industry comes along and takes that proof of concept and develops it further. And what do I mean by that? You have probably heard and you will hear even more about a particularly bold commercial venture that Motorola is moving forward with called Iridium. They're proposing to launch a 77-satellite system that would essentially be a global telecommunication

network. It is a multi-billion dollar program that they're proposing to put forward, and I would suggest that were it not for the ACTS Program, which this committee has been supporting and in which Motorola has been able to develop some technology in "the big switch in the sky," the wide band processor, that program could not possibly go forward today. And if that program does go forward, the return to the economy and to U.S. competitive leadership in satellite communication would be immense.

A second program of tremendous interest to the country, hopefully, and of interest to the membership is the search and rescue part of the NASA budget. This is a program that now really is in the NOAA Program, but NASA originally came up with the idea of using satellites for determining where pilots might be down in remote areas of the world and be able to communicate and locate them, and in the last half dozen years, it's my understanding that about 1,500 lives have actually been saved as a result of the search and rescue operation and program. NASA still has a small R&D program in this area.

If you were to combine something like the Motorola Iridium and the search and rescue operation, it would not be unimaginable to think that down the road the world might have essentially a globalized 911 system where anyone that is in trouble anywhere in the world conceivably could get themselves into a communications network that would protect human life, et cetera.

Those are just a couple of examples of the applications area that we feel that NASA is extremely instrumental in. There are others in the life sciences and materials processing, remote sensing in the weather satellite arena, and one often overlooks the great accomplishments that NASA has made in these areas and hopefully will continue to make.

Related to this is the NASA commercial programs where— now, this is not in the OSSA directorate but in the Office of Commercial Programs—they've undertaken a number of activities to generate commercial and private investment in space, and through their CCDS Program—the Centers for Commercial Development of Space—they are really, I think, pioneering in how to attract private investment in the commercial area of space, and we encourage that activity. We encourage the access to space that the university science community would have through things like Spacehab and the COMET Program.

The longer I stay here the quicker I start speaking, so you'll have to forgive me if I turn the accelerator on.

Moving now to space transportation, it's clearly critical to any space program—I think that's relevant to all of us—and particularly a dependable and economic access to space is essential. We support the joint NASA-DOD Advanced Launch Development Program again; however, we recognize that there are budget implications for moving forward with this, and this is not the only program that faces that dilemma. The NASP Program is another program that AIAA supports and some of the technology development particularly coming out of that.

With regard to Space Station Freedom, two comments. One, that while it was necessary to rescope and redefine the Space Station Program, that does not come without some cost, and all of these

rescoping exercises really do have the impact of compromising at times the integrity of the program and also resulting in future cost growth. The other point with regard to Space Station Freedom, and perhaps a difference that AIAA has with the Augustine Commission, and that is that we view the space station as having a very important role as a technology test bed or a role in testing technologies, advancing technologies in the areas such as robotics, structural design, and should not be viewed as strictly required for life sciences and materials processing.

That leads us back to one of our earlier comments, the need for supporting the basic technology program in NASA—things like CSTI, the Civil Space Technology Initiative, and other areas—and related to that, we come to the SEI Program, an area that AIAA has spent a great of time working on and working with NASA and the Space Council, and here we recognize it's particularly hard to justify a program like this in any kind of cost accounting sense, but it deserves to be really one of the goals for U.S. exploration of space, and here again we encourage a constant level of effort rather than a budgetary leftover point of view with regard to funding for that program.

Mr. Chairman, the last area that perhaps we should address, not in any detail but perhaps it really is the most fundamental, and that is the role of NASA with regard to education, and I think you've covered that here before, and we would just encourage you to recognize that, not only in terms of reenergizing the NASA work force but also how NASA serves to drive the education and the research activities in the United States itself.

As with the other witnesses, we'd be glad to answer any questions you might have. Thank you so much.

[The prepared statement of Dr. Flajser follows:]

AIAA
American Institute of Aeronautics and Astronautics

STATEMENT TO THE

SUBCOMMITTEE ON SPACE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

UNITED STATES HOUSE OF REPRESENTATIVES

ON THE

FISCAL YEAR 1992 NASA BUDGET PROPOSAL

By

Steven H. Flajser
Member, AIAA Public Policy Committee

and

Jerry Grey
Director, Science and Technology Policy

AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS
WASHINGTON, DC

March 12, 1991

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INTRODUCTION

The American Institute of Aeronautics and Astronautics (AIAA) thanks you for the opportunity to present our views on the FY92 NASA budget proposal. The AIAA is a nonprofit professional society dedicated to advancing the art, science, and technology of aeronautics and astronautics and to promoting the professionalism of those engaged in these pursuits. Our membership of over 40,000 aerospace professionals is drawn from all levels of American industry, academia, private research organizations, and government as well as from numerous nations abroad.

Given the current fiscal environment, the responsibility of Congress in determining the future of the U.S. civil space program has never been weightier. A succession of reports during the past five years has examined NASA's problems, offered visions for the future, and made recommendations. The most recent of these was the report of the Advisory Committee on the Future of the U.S. Space Program. The AIAA supports the observations and recommendations of this report. One of its recommendations is for annual growth in NASA budgets of 10% after inflation. The Administration's FY92 budget proposal is somewhat more modest, at about 8.5% after inflation.

We recognize that strong pressures to reduce the deficit will encourage Congress to seek smaller budget growth rates, and thereby introduce the danger of trading long-term paybacks for short-term gains. In considering such compromises, we urge that you be guided by three basic principles:

(1) The space technology base is the foundation on which all future space activities and capabilities depend. Support for that base must not be allowed to decay, even though much of its payoff will come in the future.

The Advisory Committee on the Future of the U.S. Space Program has recognized this key issue and recommended that the space technology base be rebuilt "if a sound underpinning is to be regained for future space missions." Indeed, they called for growth in annual technology budgets by a factor of three.

(2) Long-term programs that evolve over decades should be funded at a predictable and relatively constant level of effort, and their "milestone" goals and objectives used to measure achievement should be defined and set on the basis of that level of effort. This does <u>not</u> mean that such programs should be funded out of budget "leftovers," but that they be planned and designed as open-ended programs whose annual budgets are agreed upon by the Administration and the Congress. The Advisory Committee suggested such an approach for the Space Exploration Initiative.

Note that the space science program has operated successfully on this basis for decades.

(3) In program areas not covered by the abovestated principles, budgets for the completion of existing projects must be held in a proper balance with those for the initiation of new ones. Once a program has been approved and implemented, it should be completed on schedule and on budget. Program delays and stretchouts always increase costs, often reduce system capability, and thereby drain potential funds for new projects.

A well-balanced and vigorous civil space program is key to advancing science and technology and to improving economic competitiveness. Investments in the civil space program help to maintain our economic, political, and scientific leadership in the modern world. The U.S. civil space program is also a key element in foreign policy. The rapid growth in space capabilities overseas means that if the U.S. does not make the commitment needed for world leadership, others will.

OVERVIEW OF SPECIFIC NASA PROGRAMS

SPACE SCIENCE

Space science missions have been the foundation of the U.S. civil space program, serving to demonstrate the technologies needed for human space flight as well as providing unprecedented knowledge about the Earth, the planets, and the Universe. The Advisory Committee placed its highest priority emphasis on NASA's science program.

Voyager 2 was a prime example of the value space science programs bring in the search for better understanding and increased knowledge of the universe we live in. In addition, it illustrated that long-term benefits can be achieved with a small initial investment and a strong commitment by both the government and the people involved in the program. Besides providing valuable information for human space missions, robot spacecraft planned for the 1990s will help scientists unlock the many mysteries of our universe.

The Hubble Space Telescope, despite its difficulties, is returning valuable data that scientists have waited eagerly for, and after its planned upgrading in 1993 is expected to meet all its projected scientific goals. However, its much-publicized problems have led many to question whether NASA should continue doing "big science" projects. Although the Hubble aberration was certainly a major and unforgivable error, it was an error which the program design will be able to accommodate. Because of that sound overall management approach, which provided for Hubble to be maintained and repaired in orbit, it can fulfill all that was originally expected of it over its 15-year lifetime despite the serious primary-mirror flaw. Nevertheless, NASA has recognized that large programs are particularly susceptible to management

problems, and is therefore currently upgrading its management system with an agency-wide training program in project management, system engineering, and project control.

We also witnessed NASA's ability to troubleshoot problems with the Astro mission that flew on the Shuttle in December. Emergency efforts by science and engineering teams, including the astronauts, helped to overcome severe software problems. Because of their exemplary efforts, NASA was able to obtain data otherwise unobtainable on Earth.

Nevertheless, management of science programs continues to concern many of the scientists who often devote their careers to these projects. At its inception, the space science program enjoyed the image of a "Culture of Excellence," but that excellence is now perceived to have undergone a gradual decay. Restoring it will require that NASA re-examine and re-emphasize its partnerships with industry and the universities. Much of the work that NASA conducts in-house might be better done in partnership with these communities.

Another concern is the budget proportions allocated to large, medium, and small missions. Recent deliberations within the scientific community (the Bahcall Committee of the National Academy of Sciences) recommended a re-examination of those allocations, implying that more emphasis be given to the smaller missions. These offer more frequent flight opportunities and shorter development times, which would encourage and attract bright new talent into the science and engineering disciplines and provide training and opportunities for advancement to younger scientists and engineers. This emphasis on "small projects" should also be extended to include the lowest-cost and therefore most frequent flight opportunities offered by research aircraft, sounding rockets, and Shuttle "Getaway Specials."

A third concern of many space scientists is that NASA should be accountable for orderly completion of existing programs, and, as we stated earlier, that completion of such programs be kept in proper balance with the planning and initiation of new ones. NASA project managers, for example, often add new objectives (e.g., new technologies, higher reliability requirements) as a project evolves, thereby impacting cost, schedule, and project goals. NASA should be held accountable for the consequences of these "creeping objectives."

One solution to the accountability of mission cost growth would be to change the current practice in which management decisions are often made in isolation from overall mission costs because some mission elements lie outside the manager's scope of responsibility. The most obvious of these elements are transportation, mission operations, and data analysis. NASA should establish mission accountability practices in which <u>all</u> mission elements are integrated at the outset and managed to completion.

Proper perception of programmatic risk is also essential to the effective conduct of science missions. Hubble and Astro were designed to recognize and deal with the kinds of risks that are inherent in advanced-technology programs. Certainly, similar risks are posed by programs such as the Advanced X-Ray Astrophysics Facility (AXAF), which will study stellar structures and their evolution, active galaxies, and clusters of galaxies; and the Comet Rendezvous Asteroid Flyby (CRAF)-Cassini mission, a joint mission to Saturn and the comet Kopff. These programs should not be curtailed or compromised because of improper perception of the very real risks they involve. The future scientific return of data from these programs will prove to be invaluable to the scientific community.

One space science project essential to the support of any future exploration initiative is the Mars Observer. The Mars Observer program will augment the data collected during earlier Mariner and Viking missions by mapping the surface composition, atmospheric structure and circulation, topography, gravity, and magnetic field of the planet Mars. This information will help guide decisions on future human flights. Precursor missions with high science returns, such as the Mars Observer, have comparatively modest runout costs, are fully consistent with the Advisory Committee's recommendations, and have great merit even when viewed as individual missions. A similar case can be made for the Lunar Observer; the AIAA deplores deletion of this project from NASA's space science program.

In its report on the FY91 NASA Authorization this Committee directed that NASA undertake two workshops, one to define a program for increasing the detection rate of Earth-orbit-crossing asteroids, and another to define systems to alter the orbits of such asteroids or destroy them if they should pose a danger to life on Earth. The AIAA strongly supports this recommendation and will be participating in these workshops.

We also believe that funding for asteroid research has for many years been insufficient to build up the knowledge and capability needed to advance the field at an appropriate pace. We therefore urge the committee to increase funding for the Research Analysis line item in the Space Science budget for research on Earth-orbit-crossing asteroids. Since only limited funds are required, we recommend that this funding not detract from other programs.

The benefit-to-cost ratio of this effort could be enormous. An increase of the order of $2 million could be put to good use in grants for research to detect asteroids, to study their chemistry and physics, to plot their orbits more precisely, and to upgrade equipment. With regard to the latter it should be pointed out that the "Spacewatch telescope" at Kitt Peak National Observatory near Tucson, Arizona, which is dedicated largely to asteroid research, was built in 1921.

SPACE APPLICATIONS AND COMMERCIAL PROGRAMS

One area of NASA's program which has brought major benefits both to the U.S. and to mankind is in the applications of space-derived technology. These have appeared primarily in Earth, ocean, and atmosphere observations for both civil and national-security purposes, in various communications and position-location services, and in biomedical and materials processing. Some examples are as follows:

- Search and Rescue was originally developed by NASA with international partners and is currently run by NOAA in cooperation with many nations. The International Search and Rescue Program has demonstrated the capability of satellites to locate aircraft and marine vessels during emergencies.

- Life Sciences research has assisted in the development of air and water purification systems, aids for the handicapped, and patient monitoring systems. Biomedical and Materials Processing and other life sciences research may well provide a wealth of direct applications.

- Remote Sensing Satellites, such as Landsat and SpotImage, have been actively used by many nations to monitor weather, marine life, and agricultural development and changes. Most recently, the entire world was witness to the direct applications that remote sensing capabilities had to the "Desert Storm" operations.

Although space applications represent a relatively small portion of the budget, these activities must be strongly supported and vigorously enhanced wherever possible, both in the Office of Space Science and Application and in the Office of Commercial Programs. Such applications could well be the most important contribution of our civil space program to national competitiveness.

The increase in FY1992 funding for commercial programs is one of the most positive features of the proposed budget.

Commercial space activities involve industry, government, and academia in a common effort to generate net benefits through the commercial development of space. In the past, AIAA has identified six areas where opportunities for initiating or continuing commercial space development exist: satellite communications, Earth observations, space processing and research applicable to ground-based manufacturing, life science, transportation, and ground and orbital services.

As commercial enterprises increase their participation in U.S. space activities, NASA must play an active role in encouraging and supporting private-sector investments by expanding the agency's traditional practices of funding research, technology advancement, and demonstration of new technology areas having commercial promise, and of helping develop commercial

markets by purchasing needed goods and services whenever possible. We applaud the formal recognition of these practices by the Administration's new U.S. Commercial Space Policy Guidelines.

In this context, the AIAA supports NASA's Technology Utilization Program and particularly the Centers for the Commercial Development of Space (CCDSs). The Technology Utilization Program is designed to ease the transfer and application of aerospace technology to the private and public sector. This is a critical endeavor in establishing and maintaining the U.S. competitive position in the global market.

The CCDSs are designed to conduct research aimed at the identification of potential projects. These consortia of government, universities and industry are an excellent mechanism to encourage investment of private capital in commercial space development. It is important that the role of the private sector in these CCDSs relative to that of government continue to grow, and therefore the federal level of budgetary support should be related to private-sector participation. NASA should therefore define specific qualitative and quantitative goals to help establish that level of support, and should review the CCDSs periodically to ensure that these goals are met. Furthermore, it is clear that long-term commitments to such goals are essential if commercial organizations are expected to make the investments required for commercial success.

Many of the experiments identified by the CCDSs are dependent on the availability of limited Shuttle facilities. In the past, the AIAA has taken the position that the shortage of microgravity flight facilities is the single most critical factor limiting research in microgravity processing. For this reason we strongly support the proposed budget for the Commercial Experiment Transporter (COMET) expendable launch vehicle, which will provide long-duration microgravity exposure for commercial payloads. In addition, AIAA applauds NASA's commercial lease of a payload module that will provide pressurized man-tended capability aboard the Shuttle cargo bay. We encourage even greater use by NASA of such commercially developed systems, which might include microgravity simulation aircraft, launch vehicles, and orbiting test platforms other than COMET.

MISSION TO PLANET EARTH

As the nation considers the prospects for exploring space more intensively, it is important that we also continue to expand our knowledge of the Earth as a planet. We are becoming increasingly aware of the delicate relationship between human civilization and the global environment. The effects of deforestation, burning of fossil fuels, and widespread use of certain industrial chemicals on depleting the ozone layer, creating unacceptable air pollution and acid rain, and raising the threat of global warming are of critical importance to human survival.

"Mission to Planet Earth" is a vital program that will enable the global community to understand better how the Earth functions on a global scale. The program will gather data on the Earth's climate and weather, its atmosphere and clouds, its land, its crops, its forests, and its ocean temperature and currents. The information gathered will enable the leaders of our world to make intelligent policy decisions to protect the future of the planet and of our children.

The Earth Observing System (EOS) is the centerpiece of Mission to Planet Earth. EOS will consist of four polar-orbiting platforms, two to be provided by the U.S. and one each by Europe and Japan. These platforms will contain instruments designed to observe the Earth's land areas, atmosphere, and oceans for 15 years and thereby provide scientists with the data needed to develop comprehensive models for the accurate prediction of global change. The first of these platforms, EOS-A, will focus on land mass observations, and NASA has recently identified the suite of instruments to be flown on them. It is imperative that the Committee support the Administration's FY92 budget proposal for this first phase in order to continue the design and review of the instruments, the development of observatories, and development of long-lead components.

The second phase of Mission to Planet Earth, EOS-B, will carry instruments to concentrate on the oceans and the atmosphere. Because EOS is a long-term project and will not become available until late in the decade, and given the current fiscal environment, EOS should be funded on a "level-of-effort" basis, such as we outlined in our principle guidelines in our introduction.

A critical element of EOS is the Earth Observing System Data Information System (EOSDIS). It will be the "brains" behind EOS, consisting of Central Data Handling Facilities, a Data Archival and Distribution System, and an Information Management Center which will process, store and distribute the information obtained from the flight instruments. With programs such as EOS, NASA is entering a new era in which the large data collection capabilities of new satellites become extensive. But success cannot be achieved in this program merely by increasing launch frequency and reliability or by collecting large volumes of data. NASA must give increasing attention to assuring that the data collected are analyzed and converted into useful scientific information. For these reasons, EOSDIS is a critical element in understanding the Earth's environment and should be supported fully.

In addition to the large multidisciplinary EOS platforms, certain critical observations require unique orbits or sensor environments. The Earth Probes program addresses specific urgent problems such as ozone depletion, tropical rainfall monitoring, and monitoring of ocean winds and circulation. Earth Probe missions are also able to be built and launched quickly, filling

gaps in our knowledge of global processes before the large platforms are on orbit. The modest growth in this budget item should therefore be strongly supported.

Programs that fly in concert, such as the EOS platforms and Earth Probes, enhance the scientific return of data and ensure a sound base of knowledge. This base will enable our decisionmakers to establish the economically significant policies that will need to be made on the major environmental issues we now face. Also, a renewed focus on smaller missions, as noted earlier, has important ancillary benefits to the scientific community in the education and training of younger scientists and engineers.

SPACE TRANSPORTATION

Space transportation is the keystone for a successful U.S. space program. More dependable and economic access to space is essential, and the current U.S. mixed fleet of Shuttles and expendable launch vehicles (ELVs) must clearly be enhanced.

Because the Shuttle is our only operational manned vehicle and our largest-capacity launcher, and because it will therefore play a key role in all space activities for at least the next decade, it is necessary that it remain able to play that role. The Shuttle fleet should therefore continue to be upgraded to incorporate current technology that enhances system reliability and reduces operations costs. Failure to do so could preclude Shuttle availability and ground the U.S. manned spaceflight program long before a new operational system is available. Congress should continue its support of such Shuttle upgrade efforts.

The Advisory Committee stated that "the most significant deficiency in the nation's future civil space program is an insufficiency of reliable, flexible, and efficient launch capability." The AIAA too, has strongly urged the development of a new, lower-cost, operationally efficient space launch capability. Although the nation's currently approved space missions, both military and civil, do not by themselves require that new capability, the needs for space launch development are not mission-specific. A consensus of NASA, DOD, and the industry calls for the development of a new operationally efficient space launch capability to begin immediately.

The joint DOD/NASA Advanced Launch Development Program has focused on the technologies and system concepts needed for that capability. However, program funding in FY1991 was cut severely. Increased funding and a long-term national commitment to the development of a national launch system, which both the AIAA and the Advisory Committee have suggested should be based on the management, design, and operations philosophies of the earlier joint DOD/NASA Advanced Launch System, is needed. The initial increment of the development budget for such a system appears in

the Administration's FY92 budget proposal (it is shared equally by NASA and the Department of Defense). Support of that budget is essential to the future health of U.S. space activity.

Derivatives of current launch systems continue to be considered based on the appeal of low development cost and early availability. But derivative vehicles offer little improvement in the processes of manufacture, integration, test, and operation. Such improvement is needed for low-cost, dependable space launch capability. The AIAA urges Congress to support space launch infrastructures that focus on efficient launch system operations rather than on performance-driven vehicles. Such capabilities can be obtained neither rapidly nor at low cost, but they must be developed if the nation is to move forward from today's R&D-like launch systems to efficient, dependable, world-competitive launch systems of the future.

Commercial needs for space launch are driven by low cost, flight reliability, and schedule dependability. Government investment in the technologies, systems, and infrastructure that are aimed at applying these features to civil and military requirements will also benefit commercial interests. Such government investment would stimulate additional private-sector investment and help improve U.S. commercial competitiveness in world launch markets.

Although the current emphasis for a new launch system is derived from the joint ALS program, and properly so, Congress should not ignore the valuable new technologies emerging from programs such as the National Aerospace Plane (NASP). The highly promising advancements in materials development, propulsion, and aerodynamics could be broadly applicable both to new space launch vehicles and to advanced commercial and military aircraft. The heavy foreign investments in hypersonic technology independent of NASP are evidence of the importance this technology seems to represent to our economic competitors.

SPACE STATION FREEDOM

As stated earlier, the budget pressures on Congress are enormous, making it difficult to authorize decades-long, multibillion-dollar programs such as Space Station Freedom. This process culminated last fall in a substantial reduction in Freedom's budget plans, and a Congressional request that NASA reconfigure the station accordingly. A main concern was the ability of the Shuttle to deploy and assemble Freedom. This mandate by Congress was reiterated and strengthened in December by the Advisory Committee. But although the revisions in Freedom's planning will certainly help to address current budgetary and engineering problems, the funding instability represented by this and previous rescoping exercises could compromise the integrity of the program and increase future costs.

Freedom was identified by President Bush as the "critical next step in all our space endeavors." We agree. The station will serve as the testing ground for developing the technologies needed for human exploration of space and for immediate application in solving problems here on Earth. Permanent human presence at Freedom will provide invaluable data on the long-term effects of low gravity. And as the largest international space effort, Freedom provides a foundation for future international space activities.

During the past year Freedom was subjected to a succession of critiques addressing specific design issues, cost, and method of assembly. NASA has reacted positively, and has evolved a design and program plan to meet the changes mandated by Congress and suggested by the Advisory Committee. The program is now making the critical transition from preliminary design and review into development, hardware fabrication, and testing. Further delays will not only increase life-cycle costs; they will also delay the benefits that will accrue from early use of the station.

Our international partners will contribute nearly $8 billion to the program. Their costs grow by $200-$300 million per year for every year's delay in Freedom. Hence U.S. budget instability is of serious concern to them. Such instabilities have caused problems in the past, and will affect not only Space Station Freedom but potential future international cooperation efforts such as space exploration. Once NASA's redesign of Freedom has been established and accepted by Congress, therefore, it is important to proceed with completion of the station as expeditiously as possible, and for the Congress to provide the stable funding needed to do so.

One final point: the Advisory Committee's report recommended that Freedom's goals be limited to life science studies and microgravity research. Although AIAA has always emphasized the importance of these activities, it is necessary that some emphasis also be given to Freedom's important role in advancing, testing, and demonstrating infrastructure technologies, such as automation and robotics, innovative structural design and dynamics, and systems needed for on-orbit operations.

SPACE TECHNOLOGY ADVANCEMENT

As stated earlier, and as also emphasized by the Advisory Committee, technology is fundamental to all space activities. NASA currently has two focused programs underway to develop the hardware, software, design techniques, and data needed for future missions. The Civil Space Technology Initiative (CSTI) is developing technologies for efficient and reliable access to space, and the Exploration Technology Program will advance critical technologies in the areas of manned and robotic missions to expand human presence into space.

Both these programs represent NASA's effort to replenish the technology "bank" we have been depleting for the past two decades. There is no hope for pursuing major space exploration goals without firm, consistent commitments to these technology efforts. We urge you to continue your support of both CSTI and Exploration Technology this year, along with other cutting-edge technology advancements such as those needed for the new launch system, for Freedom's laboratory facilities, and for materials processing.

We are particularly concerned about support for the key technology programs in the Exploration Technology budget that are aimed at reducing the development risk for future exploration initiatives. These include advanced life support, power, propulsion, and aerobraking. In addition, advanced technology developments in areas such as advanced sensors, autonomous operations, and enhanced redundancy and reliability of specific subsystems are essential to many future programs, not just piloted deep space missions. Aerobraking and automatic rendezvous and docking are also needed to expand our capability for robotic planetary investigations. Although years of research and development will be necessary to perfect these technologies, they merit attention now because they are relevant to many space activities, both human and robotic. Where multiple technology options exist, parallel technology advancement programs should be undertaken until a clear choice is indicated.

The proposed Life Sciences program is strong in its objective of understanding the relative benefits of artificial gravity vs. the development of countermeasures, and in its life support technology goals. Specifically, the Radiation Biology Initiative, also known as Lifesat, is a critical element in this objective. The Lifesat spacecraft will address the effects of space radiation on living systems and will have a significant influence on programs such as the space station and the Space Exploration Initiative which require long-duration stays in space. In addition, the psychological issues associated with prolonged exposure in a confined space must be given adequate attention.

These programs, as well as other life sciences projects, will have a crucial impact on any future human exploration efforts. It should be further emphasized that life sciences research requires time as well as money. Only sequential, long duration microgravity and space radiation exposure tests can provide the necessary "ground truth" data for biological change models and countermeasure side effects. This research will likely pace any future piloted deep space exploration schedule. The Advisory Committee recognized their importance as the "long pole in the tent" of human space exploration; they should be given high priority.

SPACE EXPLORATION INITIATIVE

It is difficult to justify endeavors like the Space Exploration Initiative (SEI) in strict cost-accounting terms. Many arguments for such a program have been aired: gaining scientific understanding, sustaining international leadership, reinvigorating public appreciation of scientific and engineering values, developing tomorrow's economic base, and furthering the human spirit by searching new frontiers. We all realize that these "returns" on our space investments will accrue over time spans measured in decades and centuries, not months and years.

We cannot possibly predict all the benefits that may accrue from any specific program of exploration and discovery. But history tells us that whenever a new frontier has been opened by mankind through the process of exploration the benefits have been profound -- sociologically, scientifically, economically, and politically.

The SEI responds to mankind's basic need to explore, gives us the experience needed to learn how to travel and work in this new realm, stimulates the scientific and engineering curiosity of a generation of students, and opens new opportunities for peaceful international cooperation. We will learn more about how to operate in space just by building and assembling a space station than we have learned in all past history. By the very act of setting up an outpost on the Moon we will learn how to establish, manage, and operate a nonterrestrial base and use its resources. Developing and carrying out the missions needed to establish and sustain a permanent base on Mars will teach us how to expand further into the Solar System and, eventually, the Universe beyond.

To be successful, SEI will require increased efforts in space science and technology and a more complete understanding of how living systems react to the stresses of long-term space flight and the lunar and Martian environments. Before we can establish a lunar base or send humans to Mars we must have a better understanding of the physiological effects of long-duration space flight on the human body. The fundamental design concepts of spacecraft needed for very long manned flights depend on the results of life sciences studies such as those planned for Space Station Freedom.

The Administration's FY92 budget proposal is, we believe, overly conservative in its allocations for studies and technologies applicable to space exploration. Research on life sciences and technology advancements in propulsion and power require long lead times, and they are critical to any space exploration endeavor. Besides, these programs are also relevant to many space activities, not solely to human exploration of space. We join the Advisory Committee in urging you to increase the budgets for these studies, as well as for the entire Exploration Technology Program, or at the very least approve the Administration's limited request.

Moreover, if this nation is to embark seriously on long-term human exploration efforts, those missions must be developed methodically. Goals and objectives must be established at the outset and pursued in an orderly manner, with, of course, flexibility dictated by the evolution of technology. AIAA therefore recommends increasing the $15 million budget request for the mission studies needed to define an architecture on which to build. The outreach program the AIAA conducted for NASA this past year and the recommendations of the Synthesis Group in its forthcoming report provide valuable inputs to this process, but there is no substitute for the time and efforts of the scientists, engineers, and managers needed to devise and plan a workable, affordable exploration architecture and the systems to implement it. There is no free lunch; that time and effort must be paid for. We commend the recent re-creation of an independent Office of Exploration in NASA, and urge you to increase, or at the very least support, the Administration's request for these critical studies.

Note that the timely initiation of architecture studies allows proper structuring of contemporaneous programs having strong interrelationships with the SEI. The national launch system development addressed earlier, for example, would be expected to evolve into an SEI payload delivery system, but SEI requirements are not yet well understood. Space Station Freedom, too, can play an important role in the SEI, but architecture studies are needed to define that role more specifically.

Because of the breadth of scope of the SEI, the President has recognized that other government agencies should also be involved, and that strong efforts are needed to encourage commercial participation. Congress should therefore explore new legislation to encourage private industry, including those sectors not traditionally associated with aerospace programs (e.g., medical, pharmaceutical, construction, mining, etc.), to develop new skills applicable to SEI that will also improve their competitiveness in the international marketplace.

It is clear, however, that NASA is the only organization with the requisite technical and management capabilities to lead this effort, as recommended by the Advisory Committee. The Committee had also suggested that for long-term, "frontier-pushing" programs like the SEI, budgets should be set at an affordable annual level on the understanding that level will be sustained not just for the "out-years" of a specific project but on a continuing basis, and that the milestone accomplishments and schedules of an essentially open-ended program are keyed to that level. The previous approach, in which total programs were shoehorned into a fixed schedule and total fixed cost, with unpredictable technical problems addressed by budget overruns, is no longer either desirable or acceptable.

EDUCATION

The Space Exploration Initiative and the Mission to Planet Earth constitute a challenge to our nation today and in the years to come. The very nature of these programs requires a long-term, sustained commitment by those who inspired and initiated them and those who will follow in their footsteps. NASA will experience a high percentage of retirements within the next few years, and therefore must be given the flexibility and direction to rebuild a strong, capable, and competitive workforce both within NASA and among its supporting contractors. The recent establishment by the NASA Administrator of an Office of Human Resources is a key step in the right direction.

But simply rebuilding its current workforce isn't enough. NASA must prepare for the next century when programs like Mission to Planet Earth and the Space Exploration Initiative come to fruition, and begin preparing to meet the personnel needs they will engender. The people who will become our future scientists, engineers, and mathematicians are currently in elementary school. It is imperative that the nation plant the seeds of inspiration today in order to ensure the technically literate workforce needed to function in the high-technology world of tomorrow.

This will not be an easy task. Current studies of student capabilities show that the U.S. ranks low in the areas of math and sciences compared to other technically advanced countries. In addition, the United States graduates a smaller percentage of engineers (8% of total graduates) than Japan (20% of total) or the USSR (39% of total). Moreover, other countries are increasing the fraction of their labor force employed in science and engineering more rapidly than the U.S.

It is quite clear that U.S. technology leadership is being seriously threatened in an increasingly technologically dependent world. NASA's efforts to invigorate this vital educational issue with the establishment of the minority university research and space grant college and fellowship programs should be given maximum attention, and should be strongly supported by Congress.

But the efforts now being undertaken in the education industry, although valuable, cannot reverse the downward trend of the past two decades in mathematics, science, and engineering education. Additional support, including funding, will be required from both government and industry. Activities to improve education in these key areas could include employment of science and math teachers by aerospace companies during the summer, expanded programs of plant tours for students and teachers, proofreading and editing of science and math texts by aerospace professionals, assistance in curriculum development by corporate engineering and publication departments, regular volunteer classroom teaching by scientists and engineers on a released-time basis, after-school math and science tutoring, presentation of exciting up-to-date scientific achievements and concepts to

parents and students (e.g., at PTSA meetings), and visits to the homes of talented but underachieving students.

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We thank you for this opportunity to present our views on the FY91 NASA budget proposal, and will be pleased to respond to any questions you may have.

Attachment: CV, Steven Flajser
CV, Jerry Grey

STEVEN H. FLAJSER

Vice President, Government Relations
Fairchild Space & Defense Corporation

Steven H. Flajser is Vice President, Government Relations for Fairchild Space & Defense Corporation. He is responsible for the company's efforts which are focused on working with Congress and the Executive Branch. He has additional responsibilities for Corporate Communications.

Prior to his current position he was Director, Government Relations and previous to that held the position of Director of Space and Telecommunications Government Affairs for Fairchild Industries. He joined Fairchild in 1984 as Manager, Congressional Affairs.

Prior to his association with Fairchild, from 1975 to 1984, he served on the professional staff of the U.S. Senate Committee on Commerce, Science and Transportation and as Staff Director of the Science, Technology and Space Subcommittee.

Before coming to Washington, D.C., he served on the faculty of the University of Washington, Seattle, WA, where he helped establish their research and teaching curriculum in the management of technology. He is the author of numerous articles and publications.

Flajser is active in a number of associations including the Electronics Industries Association (EIA), the American Institute of Aeronautics and Astronautics (AIAA) and the Washington Space Business Roundtable. He has served as Chairman, National Security Industrial Association (NSIA) Legislative Information Committee and Chairman, Institute of Electrical and Electronics Engineers (IEEE) Aerospace Research and Development Committee.

He earned a bachelor of science degree from the University of California, Berkeley (1965), and a doctorate in chemistry from the University of Washington (1970).

Flajser was born 1943, in Rome, Italy. He is married, has four sons and resides in Chevy Chase, Maryland.

BIOGRAPHY

Jerry Grey
Director of Science and Technology Policy

Dr. Jerry Grey received both his Bachelor's degree in Mechanical Engineering and his Master's in Engineering Physics from Cornell University and his PhD in Aeronautics and Mathematics from the California Institute of Technology.

His early career included stints as a full-time Instructor of Thermophysics at Cornell, an engine development engineer at Fairchild, a senior engineer at Marquardt, and a hypersonic aerodynamicist at the GALCIT 5-inch hypersonic wind tunnel. He was a professor at the University of Princeton for 15 years, where he taught courses in fluid mechanics, propulsion, and nuclear powerplants. He also served as director of the Nuclear Propulsion Research Laboratory.

In 1959 he formed the Greyrad Corporation and was its full-time president from 1967 to 1971 and from 1976 to 1982 he was Adjunct Professor of Enviromental Science at the Long Island University. Dr. Grey was publisher of *Aerospace America* from 1982 to 1987 and is now Director of Science and Technology Policy for the American Institute of Aeronautics and Astronautics (AIAA). He is also a consultant to a number of government and commercial organizations and is a director at the Applied Solar Energy Corporation. He is currently a visting professor at Princeton University.

Dr. Grey is the author of 20 books and almost 300 technical papers in the fields of solar energy, space technology, aerospace policy, fluid dynamics, heat transfer, rocket and aircraft propulsion and power, plasma diagnostics, instrumentation, and the applications of technology. He has served as a consultant to the U.S. Congress (as chairman of the Office of Technology Assessment's Solar Advisory Panel); the United Nations (as deputy secretary general of the 2nd UN Conference on the Exploration and Peaceful Uses of Outer Space, 1982); NASA; the Department of Energy; the U.S. Air Force; and over 20 industrial organizations and laboratories.

He was vice president, publications, at the AIAA for 5 years, chairman of the coordinating committee on energy of the American Association of Engineering Societies, and president of the International Aeronautical Federation. He is currently a member of the Department of Transportation's Commercial Space Transportation Advisory Committee, a director of the Scientist's Institute for Public Information, a fellow of the Explorer's club and a member of the Office of Technology Assessment's Space Transportation Advisory Panel.

Jerry Grey is listed in *Who's Who in America*, *Who's Who* in Aviation and Aerospace, Engineers *of Distinction*, *Contemporary Authors*, *American Men of Science*, *National Register* of Prominent *Americans*, *Who's Who in Technology Today*, *International Who's Who in Energy and Nuclear Sciences*, *The Writers Directory*, *Blue Book*, and the *Dictionary* of International Biography. His most recent book *Beachheads* in Space was published by Macmillan in May 1983, which followed publication of his widely acclaimed book on the space shuttle, *Enterprise*.

Mr. HALL. All right. Does Dr. Grey care to——
Dr. GREY. No, I'll be happy to serve in helping——
Mr. HALL. You'll help out with the answers.
Dr. FLAJSER. He takes all the hard questions.

SCIENCE AND APPLICATIONS PERCENTAGE OF NASA BUDGET

Mr. HALL. Okay. I guess we can start out with Dr. Eden.

You know, the Augustine report recommended we set aside the 20 percent earmark for the NASA budget for science and applications, and Congress has historically gone along with this and agreed with that. What was your position on whether or not that 20 percent should include all science applications? Did you indicate that Mission to Planet Earth should be outside that percentage?

Dr. EDEN. In that, we are in agreement with the Augustine Commission that there should be a clear distinction between space science and the Missions to and from Planet Earth.

COOPERATION WITH THE SOVIETS ON MIR

Mr. HALL. Ms. Garver, you talked about international cooperation. What about some international cooperation on MIR until we get our station built? Do you see anything wrong with that?

Ms. GARVER. A number of our members have open supported that as a possibility, and we've written editorials on it in our magazine. The legislative committee which sets our policy hasn't taken a direct stand. I would see some of our members believing that that would be a problem because we want to be competitive, to the extent that it would keep us from developing our own infrastructure in the long term.

Mr. HALL. But it should help us, shouldn't it?

Ms. GARVER. Any short term efforts that could help us, we would support.

Mr. HALL. I think I'll give Steve Flajser a chance to answer that same question.

Dr. GREY. Mr. Chairman——

Mr. HALL. Dr. Grey, we'll recognize you.

Dr. GREY. Thank you, Mr. Chairman.

Actually, what Ms. Garver says is correct. There are very good applications for the use of MIR. Some of our companies have already begun that process. They have found, unfortunately, that in concept it's a great idea; in practice it gets to be very difficult. We're melding two entirely different technological bases, and I think until we're able to get those bases more or less in concert—that is, we can talk in the same technical terms, the same kind of hardware, the same kind of facilities, the same kind of data reduction capabilities—although the idea is good, it's going to be a long time before it's going to make a lot of economic sense for us to do that. I think we should work very hard in that direction.

Mr. HALL. Well, it doesn't make any economic sense to do it if we don't do it soon, does it?

Dr. GREY. Well, as I say, I think it's good for us to work hard in that direction, but it's not going to be easy, and I'm saying when you trade off the benefits——

Mr. HALL. It's not going to be easy to go out and come in again on building the space station——

Dr. GREY. Well, we need to go—as Ms. Garver said, we need——

Mr. HALL.—and if we've made some mistakes architecturally or in design or plan or expected use, then why can't we ferret out those mistakes and look at a space station that's already built and benefit by it? Frank Roosevelt had a trial-and-error method 50, 60, 70 years ago. I think Dr. Eden suggested—no, Dr. Flajser suggested that the space station would result in future cost growth. You know, what doesn't? But that's clearly a good statement.

But why couldn't we address that cost by doing some work on MIR and dropping our ego a little bit and using a station that's already in existence that might give us a breakthrough? If we get a breakthrough, for example, on finding the cure to one of the dreaded diseases and it saves us 30 days, you can take the number of deaths on any one of the dreaded diseases, and it's worth the money we'd spend on it.

Dr. GREY. Mr. Chairman, I don't disagree with that. I think we ought to work very hard with the Soviets.

Mr. HALL. But you say we work hard, but it sounds impossible.

Dr. GREY. No, I didn't say it sounds impossible. I said we've had some experiences which haven't been too good in the past. We've worked with them. We've been cooperating with the Soviet scientists now for, oh, 20 years. I was the former president of the International Astronautical Federation. We worked closely particularly in the field you mentioned, in bioastronautics. We have joint programs with them, we get their data, they get our data, and it's been working.

Mr. HALL. We didn't really give them our medical data, did we?

Dr. GREY. Oh, yes, we did, and they gave us their medical data.

Mr. HALL. Well, I understood they couldn't even get the CAT scan information because it had some of the triggering devices for some of our MXs.

Dr. GREY. You're talking in general. In specific cases, there were probably cases where they didn't give us information——

Mr. HALL. But that would be fairly general, wouldn't it?

Dr. GREY. No, I don't think so. I think in terms of the effects on the human body of the results that they have found have been traded—and the results that we have found—have been traded openly in the literature.

Mr. HALL. If we withheld medical information that would alleviate pain and suffering in the masses for a triggering device that didn't comprise 8 percent of our total device, why wouldn't we share that?

Dr. GREY. Mr. Chairman, I think you're overstating the case a bit. I don't think we have withheld that kind of information. When there has been specific technical data, sure. They would have trouble building a CAT scan machine simply because they don't have the capability to do that.

Mr. HALL. Okay.

Dr. GREY. But on the other hand, the data that we get from our CAT scan, the results are made available. I've seen those in papers at our congresses every year.

Mr. HALL. If I've overstated it, I've made my point, and I'm very interested in seeing us really pursue the use of MIR medically, if for no other reason, but I think there are a lot of other reasons, but I recognize the problems involved in docking and having to ride in their automobile, not ours.

Anyway, at this time, I recognize—Mr. Bacchus, I believe, was first in. First in, first out.

FEDERAL GOVERNMENT'S ROLE IN COMMERCIAL SPACE INDUSTRY DEVELOPMENT

Mr. BACCHUS. Thank you, Mr. Chairman. I appreciate that accountant's way of looking at privilege.

I appreciate your being here as well. I would like to pursue from a different perspective some of the line of questioning the Chairman just expressed. I, too, believe there is some potential working with the Soviets in terms of MIR and other possibilities over the long term. I think we all want to expand on our international cooperation. Clearly, Space Station Freedom itself is an example of international cooperation.

At the same time, I believe we need to independently have a very strong space program—I think most people would agree with that on this committee—and I think it's important if we're going to be a spacefaring nation to be doing business in space because that's part of our life as people. With that in mind, I'm interested in some of what you said and implied about the commercial development of our space program and specifically the American commercial space industry.

Ms. Garver, you talked about the potential in terms of using the moon for energy development and other things that might well be on the horizon but are not yet here. In the shorter term, how do you view the efforts of the Federal Government to work with our infant space industry, and how do you think those efforts could be improved?

Ms. GARVER. Yes, I think we view the efforts of the Federal Government at fostering commercial development right now as improving. Of course, this began with the commercial communication satellite industry many years ago, and the next sort of issue that came up which we tried to commercialize was the remote sensing industry. We obviously have a very poor record with the LANDSAT issue, and we see that as right now trying to be mended by the Government. The launch issue, another space commercialization issue, we feel is critical, and the bill which was passed which now stands as Title 2 we think is important to follow.

Now, we're concerned that in this year's budget now there is a recommendation for a new follow-on launch vehicle, the Advanced Launch Development Program, which may in fact hinder the development of a commercial industry. What we'd like to see are those monies that are being spent to develop technologies that they be spent in the near term on things that can be utilized by the commercial launch industry on—technology development, as Steve Flajser mentioned, was used for ACTS to help with the communication satellite industry. Those types of investments in technologies

which will in the short term help industry we believe it is most important for the Government to fund.

Then in the long term, we're looking at things like utilization of resources on the moon and so forth. Those, the Government needs to invest in a very small amount at this time in what we call the breakthrough technologies that will help potentially find those things that will really pay off, but again, those are long term.

Mr. BACCHUS. The statistics I've read indicate that only about 10 percent of Federal patents are ever applied commercially by the private sector. Do you believe that we're doing a good enough job in technology transfer to the commercial space industry from NASA?

Ms. GARVER. We believe we have a ways to go, but again, it is improving over the last couple of years, and in specific cases it's doing better than others. We've made quite a bit of progress in the launch industry, as I spoke of, and we would like to see Mission to Planet Earth and the remote sensing end come around to, again, support commercial development instead of being competitive with a commercial industry that our very country is trying to promote.

Mr. BACCHUS. Dr. Flajser, a couple of questions for you. Am I pronouncing your name correctly?

Dr. FLAJSER. Flajser. Thank you.

Mr. BACCHUS. Flajser. I have the same struggle, so I like to be understanding.

Dr. FLAJSER. You're the Senator's from Montana, is that correct?

Mr. BACCHUS. He pronounces his name wrong. [Laughter.]

I understand he's a fine man, but he's wrong about that.

You make a good point in your formal testimony about the need to provide for the development of infrastructure to support commercial space. That's a great concern of mine and, I think, of the commercial space industry. Yesterday, for example, Congressman Shaw of Florida and I introduced a bill that would provide that bonds issued by State spaceport authorities in order to build a spaceport infrastructure, launch infrastructure, would be tax exempt under the Federal tax laws in the same ways that seaports and airports are exempt on their bonds. That's one small way we can help.

How much of a role do you believe that the Federal Government should play in terms of providing infrastructure for the development of a commercial space industry in this country?

Dr. FLAJSER. That's a tough question to answer in a short period of time, but if the Federal Government didn't provide any infrastructure, there would be relatively no new commercial space activity.

Mr. BACCHUS. Because it's so costly?

Dr. FLAJSER. It is costly, it's high risk, risk technically, risk economically. The Federal Government, I think, has played a tremendous role in the past in the only area really that involves commercial space activity, and that's in the satellite communications arena. It is playing an increasing role in other areas, in the launch area. It is potentially going to play an even greater role as a result of a couple of things. One is the clarification out of the White House—recent clarification on policy for commercial space activi-

ties where the Government may be able to serve as an anchor tenant.

In other words, the role of the Federal Government in being the market, if you will, of an emerging space industry is critical, and here NASA, through its Spacehab activity, through its COMET Program, really is providing that infrastructure. For instance, the COMET Program, as I understand it, will be the infrastructure needed by a whole host of universities around the country in exploring all kinds of commercial space ventures, whether it be in pharmaceuticals, whether it be materials processing, remote sensing, whatever.

So I think the Federal Government plays, you know, a— it's vital in any commercial venture.

Centers for the Commercial Development of Space

Mr. Bacchus. A related question. The Centers for the Commercial Development of Space—you discuss them, you talk about their importance, you talk about the importance of private financing, and you say the Federal level of budgetary support should be related to private sector participation. I agree with that. We heard testimony last week that while many of these centers are thriving and while private sector support is increasing for many of the centers, nevertheless several of them are struggling and are not getting the money that they ought to.

Do you feel that we should go back and revisit the locations of those centers and give other areas a chance to show what they can do in terms of attracting private financing?

Dr. Flajser. I can't address that specifically without looking at individual centers, but I think it's fair to recall that there was this euphoria in the early 1980s of commercialization of space only to have it meet the cold, wet blanket of reality, namely these ventures take an incredibly long period of time to develop, many of them do. The markets don't exist for many of these ventures, and to indicate, one, that you want to have some joint risk taking between the Federal Government and the private sector is good, but to put a time table and say the Federal Government should back out within, say, five years, well, in some ventures in some centers perhaps that's appropriate, with others perhaps that's not appropriate.

The other point to make is that there's no guarantee of success in any of these ventures. That's the nature of the marketplace, and some of them will hopefully succeed, and others may not succeed or may not succeed in time.

Mr. Bacchus. Of course, our foreign competitors have faced these same risks, and one of the reasons that we've struggled is because of our lack of any reliable launch vehicle and some of the troubles we've had by placing all of our eggs in the shuttle basket. Why have they succeeded otherwise where we have not? Why are we falling behind in some respects in terms of commercial base and our competition with other nations?

Dr. GREY. Let me take a crack at that, Mr. Bacchus. There are really two reasons. First, the viewpoint by other nations, and particularly that of Japan, is a willingness to invest in very long term technologies that may not pay off for decades. My favorite example is the decision that the Ministry of International Trade and Industry of Japan made in 1961 to begin the process of assembling technology and teams of manufacturing expertise in the manufacture of random access memory chips for a non-existent market in 1961. Twenty years later, they took over the world market in what became a very lucrative product.

And I think one of the problems we have in this country, both in our Government and in industry, is the tendency to look upon advanced technology as requiring a relatively short term return or else we won't invest in it. Or if we begin investing, we cut off funds after we see nothing happening for several years.

Mr. BACCHUS. I think that's certainly a consideration, and I think you're correct insofar as you've stated it. Are we not also facing the reality that many of these countries are subsidizing their industries and that especially in non-market economies we're facing what amount to subsidies?

Dr. GREY. Oh, there's no question that that's occurring. On the other hand, we can counteract that in ways that are quite effective in terms of the market. And again, I quote the market that Dr. Flajser said, and that is the satellite communications market. We took over that market at a very early stage because in effect the Government did subsidize the technology development in that field. We are now seeing dangerous indications that Japan—for example, Toshiba—has now decided that it is going to bid on the next generation of communication satellites because of technology they've gained.

Now, the point is we can invest as a nation in these technologies, and one of the prime examples that's before this committee, I think, is the funding for a new national launch vehicle, a technology which we need desperately in this country. If we're going to see any of the space developments from a commercial point of view that we want to see in the future, we have got to bring down the cost of launch vehicles and increase the reliability. This is what the commercial companies need, and our country can subsidize that technology development for use by private industry.

Mr. BACCHUS. I agree with you on that.

One final question, Mr. Chairman, of Dr. Grey.

Given the concerns that we have about the continuing development of our commercial space industry in this country and our own ability to launch commercial satellites, do you think it was wise for the President last year to grant an export license to allow the Chinese to launch an American-made satellite on one of their Long March rockets?

Dr. GREY. From the viewpoint of our launch industry, absolutely not. From the overall viewpoint of U.S. economics, there were some arguments that he cited which were pretty good ones, mainly we may have lost the construction of the satellite, which was a much

larger investment than just the launch vehicle itself. It's a complex process. There's no simple answer.

Mr. BACCHUS. Yes, of course. Thank you, Dr. Grey.

Thank you, Mr. Chairman.

Mr. HALL. If Mr. Bacchus would yield and if Mr. Rhodes would yield just a moment, Ms. Garver was moving around uncomfortably on some of those answers about subsidies from foreign markets.

Would you like to put something in the record about it at this time?

Ms. GARVER. Sure. We're on the record. In fact, the National Space Society filed a draft 301 petition against what we would consider dumping by the Chinese for the pricing of the satellites. We have an agreement right now through the U.S. Trade Department which does state specific constraints by which the Chinese can launch U.S. satellites.

Mr. BACCHUS. Are you saying the Office of the United States Trade Representative?

Ms. GARVER. Yes. I'm sorry. The Trade Representative's office has not fully responded to this concern and partly because, we feel, during the war in the Middle East, the Chinese were brought on board, and no one wanted to do anything in the Administration to upset the Chinese. However, we do feel this continues to be an issue, one that the Trade Representative is continuing to work to try and find out if in fact the Chinese are dumping.

Mr. BACCHUS. Ms. Garver, I'd be very interested in seeing that information if you could share it with my office. I'm not worried about offending the Chinese.

Ms. GARVER. I'd be happy to do that. Thank you.

Mr. BACCHUS. Thank you.

Mr. HALL. The Chair recognizes the gentleman from Arizona, Mr. Rhodes.

Mr. RHODES. Thank you.

Mr. Rhodes, just for starters, in the material you provided to us you included a survey that your organization has done. I'd like to have this in the committee record if you don't object.

Ms. GARVER. We have submitted it for the printed record, yes. Thank you.

ACCESS TO SOVIET LIFE SCIENCES DATA

Mr. RHODES. And for you, Ms. Garver, and for Dr. Grey, again on the question of MIR and shared information. One of the, obviously, most valuable pieces of data or information that we will learn from our space station will be the effects of microgravity on humans. Certainly, the Soviets have a wealth of information, or experience, at least, on having humans in a microgravity environment. Have they shared with us what they've learned about the impact of microgravity on human beings, and does their data appear to be good data, valuable data, data that we can use?

Dr. GREY. You've just identified the key question, Mr. Rhodes. They do share their data. They have been open with it. As I say, in our bio-astronautic sessions at the international congresses, they give paper after paper on their results. The problem has been always that the quality of their instrumentation and the quality of

their experimental procedures is not really satisfactory from the point of view of the data that we need to obtain, and they recognize that. They fully understand that they are taking data.

They would love to cooperate with the U.S. experimenters because they recognize that we do have good instrumentation, and they have the access to the facilities, and that's why the cooperation that I suggested before is an excellent idea if we can pursue it. Our problems, again, relate more to the mechanical difficulties of correlating our systems with their systems, and there is an effort under way to continue to work on that, but it's a difficult problem. And as I say, most of the data they have have not been able to be used simply because the instrumentation and the techniques have really not been adequate.

Mr. RHODES. Ms. Garver, do you have anything to add to that?

Ms. GARVER. Well, I think we feel that that is an area potentially that could be most beneficial for cooperative efforts. When we talk about going to Mars especially and we need that data, we feel that it would be most important if we can't wait for our own data on Space Station Freedom, or if for some reason we don't have that available, to be able to use that would be, in our minds, very beneficial to the long term program.

NASA's Role in Education

Mr. RHODES. I just have to observe, Mr. Chairman, that like you and, I guess, like Mr. Bacchus and probably a lot of us, I've been intrigued by the possibility of working with the Soviets on MIR, and I've basically come to the opposite conclusion of you, and it's not because of any Republican reasons like evil empires and red Commie rats and that sort of thing, but simply because we all know how finite our own resources are, and I'm concerned that if we began to work on an intensive effort to try to utilize MIR that it would divert resources away from Freedom that we really can't afford to do if we want to keep Freedom on track. So I wanted to share that observation with you.

Dr. Flajser, at the close of your testimony, you mentioned NASA's role in education, and I'd like for you to expand on that a little bit. Frequently, we hear that keeping a robust, exciting space program will cause young people to become fascinated by space and therefore fascinated by space sciences, by engineering, by mathematics and that they will then evolve themselves into the educational process. Is that really what you're talking about, just sort of a metamorphosis, or are you talking about an explicit role for NASA in improving the educational process in this country?

Dr. FLAJSER. Well, I think it's a combination. First of all, it is a stimulus to the young people to get involved in science and engineering, whether they pursue it in space or medicine or wherever. Secondly, it is a place that drives technology in the nature of the work that it supports, so that it's a stimulant as well as a marketplace, if you will, for scientists and engineers.

The other factor, though, is that the work force in NASA is aging, and the ability of NASA to attract the most capable people, the brightest minds, if you will, is harder today than it was obviously 30 years ago, when it was a brand new agency with a mis-

sion, and the incentives, if you will, to make a career at NASA, or at least a large portion of a career at NASA, are not as great today as they were in the past. I think the Administrator and others at NASA recognize that, and they're taking steps to improve that.

Mr. HALL. Okay. We have just a few minutes now to go vote, and I think you've been a very good panel, and we would like your cooperation in submitting some additional questions to you, and we certainly thank you for your time.

I'm disappointed to learn that the gentleman from Arizona doesn't agree with me on MIR. I'll just make a notation he needs some more work done on him. [Laughter.]

Mr. HALL. I started to say your time had expired, but——[Laughter.]

No, there's two sides to all of this, and that's what we're really doing now is probing to try to come up with that that we really should do, and you've been great help and great assistance to us. We appreciate what you have done and what you are doing and what you will do for this subcommittee and for the big committee and for the Space Program and for this country. Thank you very much.

Now, to Dr. Patricia Reiff and to George Sponsler and to David Gleich and to Arvid Larson, we will be back in just a little bit. We're going to go vote. We'll be back. Wait right here for us.

[Recess.]

Mr. HALL. All right. Even though there are people coming in and out—there are other hearings today—we'll get under way with the testimony because it's important that your testimony get of record, and then, of course, it will be distributed to all of the other members. So you're not just testifying to a chairman and a staff person or two. They are all here either by staff or they will have part of the record.

We're honored to have George Sponsler, III, David Gleich—did I say that correctly, David?

Mr. GLEICH. Gleich.

Mr. HALL. Gleich. Okay. I said it incorrectly. And Dr. Larson, and we have Dr. Patricia Reiff, who is from Rice University and has testified many times before this committee. She had plane trouble getting up here. She was on the first panel, but she traded places with Dr. Flajser, and she's an active member of the Space Science Working Group, serves on that organization's steering committee, and we're going to get her back up here sometime to testify for George Brown about electric cars. That's one of his major interests. So I don't know hardly how we can work an electric-propelled vehicle into the Space Program yet when they can't go from Dallas to Fort Worth, but we'll try to work that in later.

And I think at this time we'll recognize you, Dr. Reiff.

STATEMENT OF DR. PATRICIA REIFF, SPACE SCIENCE WORKING GROUP

Dr. REIFF. Good afternoon.

Mr. HALL. If you would, pull it right down close to you where we can hear you.

Dr. REIFF. My name is Patricia Reiff, and I want to thank you for this opportunity to speak on NASA's 1992 budget request. I speak today on behalf of the Space Science Working Group, a committee of the American Association of Universities, comprised of approximately 180 scientists at over 20 universities. These institutions represent most of the leading universities performing space research. In formulating our position on the agency's request, we have not only asked our own members for input but have also discussed space issues with scientists at other universities and national laboratories.

The first matter I'd like to address is not budgetary per se, but rather our collective response to the Augustine report. The scientific community wholeheartedly endorses these recommendations. Certainly, individual scientists have concerns in specific areas, but on balance we are extremely pleased with the report's emphasis on the crucial importance of space science. This is particularly gratifying since the makeup of the Augustine panel was predominantly from industry and not from the science community.

The second point I would like to make is that, although the SSWG has some specific concerns about NASA's 1992 budget, we feel that such concerns should not be corrected at the expense of the funded programs. Such actions should be taken only if new funds are identified. This budget, though large, is quite lean. Major cuts would have serious effects on the community.

The Space Science Working Group supports the proposed 1992 request for NASA. This budget reflects the Nation's high priority for science and the promise which a rejuvenated and focused program could bring to the country as a whole. Despite its recent increases, the NASA budget totals are still far below their peak in the days of the Apollo program, when the overall objectives were perhaps more political than scientific.

The Augustine Committee has now given the Space Program a much more clearly defined and ultimately important overarching goal—the pursuit of space science. The SSWG endorses this goal and finds the 1992 budget to be fully consistent with its implementation. The relative increase in the proposed budget for the Office of Space Science and Applications—OSSA—is consistent with the mandate of the Augustine report.

The OSSA budget allows for the continued orderly implementation of the long range strategic plan so carefully developed by NASA and the scientific community. It includes funds for the continued development of major missions already started, modest growth in small missions of the orbital programs, initiation of LIFESAT, and support for both mission operations and data analysis, which we call MO&DA, and also research and analysis—R&A.

At this point, I'd love to spend a half-hour reviewing the exciting science that has been done in the past year and the plans for the next few years, but because of time, suffice it to say that this decade will be looked upon when space science matured from fly-by science to detailed exploration of the planets and the great observatories observing space.

Despite our overall support of the budget, we have a number of specific concerns. The cancellation of attached payloads on Space Station Freedom removed several excellent experiments from the

Flight Program. In addition, the recent downsizing of the station has threatened its life science goals by reducing the number of astronauts and removing the commitment to a permanently manned station as required for long duration studies of humans and animals.

There were several Space Physics Division payloads which were removed from the EOS-A platform. These experiments had a particularly heavy university involvement, and their loss is thus especially disturbing, since these groups have only limited ability to absorb drastic disruptions. The SSWG is also concerned that NASA has not yet assigned a launch vehicle for the COMET rendezvous mission—CRAF. With the cancellation of the Space Station Freedom attached payloads, we see a sad repeat of the experience with the space shuttle, where an avenue of frequent and assured access to space suddenly disappears with no replacement in sight.

Growing spacecraft costs in the Delta class and small Explorer class have stretched out the queues in these programs. The Delta-class explorer queue is now filled through the end of the century. The SSWG supports a major boost for the Explorer Program, including a new intermediate class between the small explorers and the Delta class in the Explorer Program.

There were welcome infusions of R&A support in the Space Physics and Planetary Divisions; however, the R&A and MO&DA lines are still greatly oversubscribed. An extended mission for Magellan is an excellent example of an important task that will put additional pressure on R&A.

The squeeze on R&A funds has been exacerbated by the holding back of Phase-B funds for the Orbiting Solar Laboratory, Lunar Observer, and SIRTF. Prudent planning requires that these missions be carefully studied before any new start, and yet this effort is being hampered by the fact that these studies must be funded out of R&A. It is critical that R&A funds be protected from "taxes" and "raids" to meet overruns on other particular mission programs. We would also like to see the 1993 budget request include increases for sub-orbital programs and for continued analysis of data from older missions.

Finally, as stressed in the Augustine report, the core of the Space Science Program is of the highest priority. Therefore, Mission to Planet Earth and Mission from Planet Earth should be funded independently of the core program. Moreover, Mission from Planet Earth, with its long range objectives of moon and Mars exploration, should be prevented from causing the well-formulated plans for robotic exploration of the moon and Mars to be delayed while the program is itself defined.

The SSWG emphasizes its earlier concerns that the Mission to Planet Earth as embodied in the EOS Program should not be allowed to displace the remaining core programs in space science. The SSWG agrees with the Augustine report that both Mission to Planet Earth and Mission from Planet Earth as major and long term programs should be carried out at an affordable rate and in addition to the core Space Science Program, which should continue to receive approximately 20 percent of the NASA budget. Thank you.

[The prepared statement of Dr. Reiff follows:]

Testimony of

Dr. Patricia Reiff

on behalf of

the Space Science Working Group

Hearing on NASA's Fiscal Year 1992 Budget Request

House Committee on Science, Space and Technology's

Subcommittee on Space

March 12, 1991

Good afternoon. My name is Patricia Reiff, and I want to thank you for allowing me this opportunity to comment on NASA's Fiscal Year 1992 budget request. I speak today on behalf of the Space Science Working Group, a committee which operates under the auspices of the American Association of Universities and which is comprised of approximately 180 scientists at over 20 universities. These institutions represent most of the leading universities performing space research. In formulating our position on the agency's request, we have not only asked our own members for input, but have also discussed space issues with scientists at other universities and national laboratories.

The first matter I would like to address is not budgetary *per se*, but rather our collective response to the Augustine Report. As mentioned in written testimony submitted by our Chairman, Josh Grindlay, earlier this year, the scientific community wholeheartedly endorses these recommendations. Certainly individual scientists have concerns in specific areas, but on balance we are extremely gratified with the Report's emphasis on the crucial importance of space science. This is particularly important since the makeup of the Augustine panel was predominantly from industry and not from the scientific community.

The second point I would like to make is that, although the SSWG has some specific concerns about NASA's Fiscal Year 1992 budget request, we feel that such concerns should not be "corrected" at the expense of funded programs. Such action should be taken only if new funds are identified.

General Overview

The Space Science Working Group (SSWG) supports the proposed FY1992 request for NASA. This budget reflects the nation's high priority for science and the promise that a rejuvenated and focused program for science in space can bring to the science, technology and education base of the country as a whole. Despite its recent increases, the NASA budget totals are still far below their peak in the days of the Apollo program, when the overall objectives were perhaps more political than scientific. The Augustine Committee has now given the space program a much more clearly defined, and ultimately important, overarching goal: the pursuit of space science. The SSWG endorses this goal, and finds the FY1992 budget to be fully consistent with its implementation. The relative increase in the proposed budget for the Office of Space Science (OSSA) is consistent with the mandate of the Augustine Report.

The OSSA budget allows for the continued orderly implementation of the Long Range Strategic Plan so carefully developed by NASA and the scientific community. It includes funds for the continued development of the major missions already started (AXAF, CRAF/Cassini), modest growth in small missions (Explorers) and suborbital programs, initiation of Lifesat, and support for both Mission Operations and Data Analysis (MO&DA) and Research and Analysis (R&A).

The SSWG is pleased to note the many exciting Space Science missions which got underway during the past year. The nation was rewarded with fascinatingly detailed pictures of Venus returned from Magellan and of the Moon's far side from Galileo. The Hubble Space Telescope, although troubled with mirror problems, began returning unique data in the UV and planetary area. ROSAT was successfully launched, resuming our X-ray astrophysics studies after a long hiatus reaching back to the time of the Einstein

Observatory, and COBE completed its measurement of the afterglow of the birth of the universe. The long-awaited launch of the Ulysses deep space orobe ushered in an exciting new phase on our exploration of the heliosphere. After th exciting flybys of the outer planets by Pioneer and Voyager, Galileo begins our detailed exploration of these fascinating worlds by its orbital mission to Jupiter. In addition, the launch of the CRRES mission, and subsequent successful initiation of its series of chemical releases, inaugurated the Global Geospace Science program of multiple spacecraft studies of the magnetosphere and interplanetary medium near Earth. Finally, the Shuttle flight of the ASTRO mission brought new insights in the the UV and X-ray sky, mapping energetic stars in our galaxy.

The pace of missions continues in 1991, with launches scheduled for GRO (the Second Great Observatory), the first of the long-awaited life sciences missions (SLS-1 on Spacelab), and the UARS mission. The SSWG looks forward to the clarification of a restructured space station, which would primarily serve life sciences and microgravity research as recommended in the Augustine Report.

Concerns

We do, however, have a number of concerns regarding several of the on-going programs. The cancellation of the Attached Payloads from Space Station Freedom removed several excellent experiments from the flight program; in addition, the recent downsizing of the program has threatened the life-sciences goals of SSF by reducing the number of astronauts, and removing the commitment to a permanently manned station as required for long-duration studies of humans and animals. There were several Space Physics Division payloads removed from the EOS-A platform; these experiments had a particularly heavy university involvement, and their loss is thus made especially disturbing since these groups have only limited ability to absorb drastic disruptions. The SSWG is also concerned that NASA has not yet assigned a launch vehicle for the CRAF mission.

With the cancellation of the SSF Attached Payloads, we see a sad repeat of the experience with the Space Shuttle, where an avenue of frequent and assured access to space suddenly disappears with no replacement in sight. Growing spacecraft costs in the Delta-class and Small Explorer (SMEX) have stretched out the queues in these programs; the Delta-class explorer queue is now filled to the end of the century. The SSWG supports a major boost for the Explorer program, including a new "intermediate class" (between SMEX and Delta Class) Explorer program.

There were welcome infusions of R&A support in the Space Physics, and Planetary Divisions; however, the R&A lines in the OSSA budget remain heavily oversubscribed. Similarly, the MO&DA line, while increased for Physics and Astronomy, is still greatly oversubscribed. An extended mission for Magellan is an excellent example of an important task that will put additional pressure on R&A. The squeeze on R&A funds has been exacerbated by the holding back of Phase-B funds for the Orbiting Solar Laboratory (OSL), Lunar Observer and SIRTF. Prudent planning requires that these missions be carefully studied before any new start, and yet this effort is being hampered by the fact that these studies must be funded out of R&A. It is critical that R&A funds be protected from "taxes" and "raids" to meet overruns on particular mission programs.

Finally, as stressed in the Augustine Report, the core of the space science program is of highest priority. Therefore, the Presidential Initiatives Mission to Planet Earth (MTPE) and Mission from Planet Earth (MFPE) should be funded independent of the core program. However, MFPE with its long-range objective of Moon and Mars exploration, should not be implemented to the detriment of either the coherent and systematic plans for unmanned exploration of the Solar System or cause the well-formulated plans for robotic exploration of the Moon and Mars to be delayed while the MFPE program is itself defined. The SSWG emphasizes its earlier concerns that the Mission to Planet Earth, as embodied in the EOS program, should not be allowed to displace the remaining core programs in space science. The SSWG agrees with the Augustine Report that both MFPE and MTPE , as major and long-term programs, be carried out at an affordable rate and in addition to the core space science program, which should continue to receive approximately 20% of the NASA budget.

Patricia A. Reiff

Patricia A. Reiff received her Ph.D. in Physics from Rice University in 1975. Her early research focused on the analysis of space plasma data from the Apollo missions.

Since that time, Dr. Reiff has continued her study of space plasma data, concentrating on information received from the Atmosphere Explorer and the Dynamics Explorer spacecrafts. Dr. Reiff is also a co-investigator on both the magnetometer instrument on the POLAR spacecraft and the plasma instrument on the CRAF mission. In addition, she is presently a distinguished faculty fellow at Rice University.

Dr. Reiff is an active member of the Space Science Working Group and serves on that organization's Steering Committee.

Mr. HALL. All right. The Chair will recognize now George Sponsler, III, who is Chairman of the Aerospace R&D Policy Committee, Institute of Electrical and Electronics Engineers.

I recognize Dr. Sponsler.

STATEMENT OF DR. GEORGE C. SPONSLER III, CHAIRMAN, AEROSPACE R&D POLICY COMMITTEE, INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, WASHINGTON, DC

Dr. SPONSLER. Thank you, Mr. Chairman.

It's an honor and pleasure to be here this morning on behalf of the IEEE-USA. As you know, IEEE-USA has some 240,000 USA members and some 50,000 other international members, which makes us the largest professional society in the world.

I, too, will speak of the 1992 NASA budget authorization in the context of the Augustine report, as did Dr. Reiff, but I fear we have some disagreement, which I will emphasize. I will not read my testimony which has been submitted. I shall, however, highlight certain portions.

For example, our comments on both the NASA budget and Augustine report reflect our concern that current and planned Federal civil space expenditures do not contribute to the U.S. commercial and technological leadership to the degree they sometimes have in the past and could and should, we believe, in the future.

We are particularly concerned that Public Law 98-361, which charges NASA to assist the private U.S. space industry, has been more honored in the breach than followed. We're particularly concerned that little attention has been given to space applications after a very promising beginning with communications and earth observation satellites. The modern ACTS—Advanced Communication Technology Satellite—has languished despite continued Congressional support, and the LANDSAT, in our view, has been a commercial fiasco.

Although we agree for the most part with the Augustine report, our principal disagreement is with its primary recommendation. We believe the first priority of NASA should not be to support science, per se, but rather to use space to improve U.S. economy, education, our environment, and the quality of life here on Earth—the latter including the satisfaction, pride, and sense of accomplishment gained through space science. Our hope is that the word "science" as used by the Augustine report really implicitly includes technology—that is, science applied to the needs of society—as we believe that such science—that is, technology—better justifies the use of public monies to support our Nation's space operation.

We are somewhat concerned in looking at the 1992 budget authorization request that the budget fundamentally, in our view, represents a continuation of the status quo NASA policies of the past. This point was emphasized by NASA Administrator Admiral Truly himself at his February 4, 1991, press conference, when he remarked that "99 percent of the budget supports programs that have already been approved."

We also take some issue with Admiral Truly's statement or at least his support of Space Station Freedom as being "the cornerstone of America's space exploration program." You may recall

that last year there were three principal objectives or raison d'etre for the Space Station, one of which has been jettisoned, which is the use of the staging point on the way to the moon and Mars. We now only have life sciences and microgravity research, and our concern is that those two by themselves may not justify a further expenditure on the order of $15 billion or perhaps $30 billion.

We do support the Augustine report in the emphasis it gives to the Mission to Planet Earth with a stretched out, more modest mission from Earth to the moon and Mars. We particularly support the Earth Observation System—EOS—Program, a major component of the Mission to Planet Earth, and we think special attention should be given to the accompanying Data and Information System—the EOSDIS—Program, which would assure the proper use of the massive amounts of data which will be collected by EOS.

However, both the proposed NASA budget and the Augustine report make little mention of the currently reduced state of U.S. capability in space applications. They fail to acknowledge the growing international competition in space applications, and they do not propose plans or recommend acceleration of NASA's efforts in such efforts.

We are particularly concerned about the lack of emphasis on space applications. In the mid-1970s, NASA took two unfortunate steps. It stopped developing and launching experimental communication satellites, and it turned responsibility for remote sensing satellites over to the National Oceanographic and Atmospheric Administration—NOAA. Neither of these have been particularly successful. As a result, the United States is no longer the undisputed leader in these two fields. Indeed, in several relevant fields of technology, the United States is now behind both Europe and Japan.

The Advanced Communication Technology Satellite—ACTS—is a particular concern of ours. Five hundred million dollars has been spent of taxpayers' monies on ACTS, and yet scant attention has been paid to how it will be used in orbit after its planned 1992 launch, and an inadequate network of ground terminals has been proposed to test and demonstrate the satellite, and not a sufficient number of major U.S. telecommunication carriers are involved with the program.

As an example of what we think is an undue emphasis on science, we point to the Remote Sensing Applications Program for EOS. The current program is devoted to long term scientific measurements of the type needed to measure climatic changes, but that data is of little use to the weather forecaster, farmer, forester, or land use manager.

We are also concerned about interagency management or lack thereof. There seems to be inadequate cooperation, in our view, between NASA and DOD, for example, on ACTS and Milstar, and we think that there's an inadequate and poor coordination between NASA, NOAA, and in certain cases, the Department of Commerce. We believe stronger mechanisms are required to address this critical problem.

We also feel that insufficient emphasis has been given to the general area of sophisticated technology, which has been employed in putting man in space and exploring the planets in such a marvelous fashion. Yet in spite of NASA's 20-year-old technology trans-

fer program, the U.S. today lags behind Japan and other countries in many critical, commercially important technologies.

Part of this problem, we think, is in the NASA technology transfer process, which has not been as efficient as we would like. We identify four principal areas of failing. One, the unit cost of space assets are so high as to stifle entrepreneurial business activities; two, the U.S. needs new, useful, and affordable space goals particularly emphasized to gain or improve our economic competitiveness; three, increased attention should be given to space applications for the practieal benefits to mankind on Earth; and we need more emphasis on space technology to enhance U.S. aerospace leadership.

For this reason, IEEE-USA suggests two sets of action for the Congress' consideration. One, Congress should formulate policy and set goals for the U.S. in developing space applications; and two, Congress should formulate policy and set goals for the U.S. to enhance U.S. technological leadership, particularly in the transfer of NASA-supported space technology into the private sector.

The past two years have been extraordinary. They've seen the Cold War diminished and the Persian Gulf won. The role of technology in the Persian Gulf war is well understood. It is not generally understood that space was the key battleground for the Cold War wherein the United States demonstrated the preeminence of its free enterprise-based technology. Now we can fight a new sort of war: international economic competition. IEEE-USA believes that technclogy, particularly aerospace technology, once again will help carry the day, and that should be the objective of both the NASA program and the President's budget. Thank you, Mr. Chairman.

[The prepared statement of Dr. Sponsler follows:]

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STATEMENT TO THE
SUBCOMMITTEE ON SPACE
OF THE
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

ON THE

FY 1992 NASA BUDGET AUTHORIZATION AND CIVIL AEROSPACE POLICY

BY

GEORGE C. SPONSLER, III

CHAIRMAN
AEROSPACE R&D POLICY COMMITTEE
INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS - UNITED STATES ACTIVITIES

MARCH 12, 1991

STATEMENT TO THE
SUBCOMMITTEE ON SPACE
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

on the

FY 1992 NASA BUDGET AUTHORIZATION
AND CIVIL AEROSPACE POLICY

by

George C. Sponsler, III
Chairman
Aerospace R&D Policy Committee
Institute of Electrical and Electronics
Engineers - United States Activities

Good afternoon Mr. Chairman and Members of the Committee. My name is George C. Sponsler and I serve as Chairman of the Aerospace R&D Policy Committee of the Institute of Electrical and Electronics Engineers - United States Activities (IEEE-USA). In response to your invitation, I am pleased to present the views of the IEEE-USA with regard to the 1992 NASA budget authorization proposed by the President. I do so in the context of the recent Report of the Advisory Committee on the Future of the U.S. Space Program chaired by Mr. Norman R. Augustine.

With more than 240,000 U.S. members in its United States Activities and over 60,000 overseas, the IEEE is an international organization as well as the world's largest technical, professional association. Many of our members are employed in space technology, which we view as a major force in economic progress and which could be a key to sustaining U.S. commercial competitiveness. Our comments on both the NASA budget and the Augustine report reflect our concern that current and planned federal civil space expenditures do not contribute to U.S. commercial and technological leadership to the degree that they sometimes have in the past, and could and should in the future.

Public Law 98-361 charges NASA to assist private U.S. space industry, and thus to enhance our Nation's commercial competitiveness, through technology transfer and economic growth; but to date little has been accomplished along these lines. Even with our most successful space applications--communications and earth observation satellites--after promising beginnings, the government has failed to fully exploit the technologies. The modern Advanced Communcations Technology Satellite has languished despite congressional support, and Landsat has been a commercial fiasco.

For reasons such as these, although we agree for the most part with the Augustine report, our principal disagreement is with its primary recommendation: we believe the first priority of NASA should not be to support science, per se, but rather to use space to improve the U.S. economy, education, our environment, and the quality of life here on earth--the latter including the satisfaction, pride, and sense of accomplishment gained through space science and applications. Our hope is that the "science" which the Augustine report so strongly supports implicitly includes technology and would be applied to the needs of society, as we believe that objective better justifies the use of public monies to support our nation's space operations.

The basic problem we see with the proposed NASA budget is that, while acknowledging the Augustine report's recommendations, the budget request fundamentally represents a continuation of status quo NASA policies of the past.

This point was emphasized by NASA Administrator Admiral Truly himself at a February 4, 1991 NASA budget press conference when he remarked: "...99 percent (of the budget) supports programs that have already been approved." He went on to say that "...many of the critical elements of the Augustine report are resource-dependent and will require the support of Congress," thus implying that, were NASA to implement more fully the Augustine report, more monies would be required.

Admiral Truly also reemphasized the Administration's support of the planned space station: "Space Station Freedom is the cornerstone of America's space exploration program." But one of its three former raison d'etre, as a way station or staging point for a manned mission to the Moon and Mars, apparently has been abandoned in favor of the remaining two objectives: life sciences and microgravity research.

Although Admiral Truly said that NASA "will soon complete the review of the station's design and assembly sequence in response to direction from Congress," (and NASA has subsequently announced that it has succeeded in reducing both the size and cost of the space station) it is not apparent from the proposed 1992 budget request that NASA really supports the recommendation of the Augustine report that the space station should be substantially reduced in both scope and cost.

Nor is it apparent from the proposed budget that NASA supports the Augustine Report priorities: giving major emphasis to the Mission <u>to</u> Planet Earth, with a stretched-out, more modest mission <u>from</u> Earth to the Moon and Mars.

IEEE-USA agrees with the Augustine report that the Earth Observation System (EOS) program--a major component of the Mission <u>to</u> Planet Earth--is particularly deserving, because of the current lack of understanding of the global biosphere and changes taking place therein. Special attention should be given to the accompanying Data and Information Systems (EOSDIS) program to assure proper use of the massive amounts of data to be collected by EOS.

Both the proposed 1992 NASA budget and the Augustine report make little mention of the currently reduced state of U.S. capability in space applications, fail to acknowledge the growing international competition in space applications, and do not propose plans or recommend acceleration of NASA's efforts therein.

Space applications--principally satellite communications and remote sensing--have offered great practical benefits from the earliest days of NASA's space program. But in the mid-1970s, NASA took two unfortunate steps: it stopped developing and launching experimental communciations satellites; and, it turned responsibility for remote sensing satellites over to the National Oceanic and Atmospheric Administration (NOAA). These actions were motivated in part by the assumption that both areas had become "operational" and that further NASA involvement in experimentation and technology development was no longer necessary.

But other countries recognized the great potential for satellite communications and remote sensing, and proceeded to develop their own technologies and systems. As a result, the U.S. is no longer the undisputed leader in these two fields; indeed in several relevant fields of technology the U.S. in now behind Europe and Japan. In fact, our government has actually impeded progress in satellite communication by some of its actions to deregulate the telecommunications industry, and in remote sensing by its less than successful attempt to commercialize Landsat.

NASA's only current applications program, the Advanced Communications Technology Satellite (ACTS), has not been supported strongly within the agency or by the Administration. While $500 million of the taxpayer's money and a decade of effort have been spent developing ACTS, scant attention has been paid to how it will be used in orbit after its planned 1992 launch. An adequate network of ground terminals has not been built to test and demonstrate the satellite and major U.S. telecommunications carriers and users are not involved.

NASA has also gradually phased out remote sensing applications in favor of its scientific aspects. The current program is devoted to long term scientific measurements of the type needed to measure climate change; but that data is of little use to the weather forecaster, farmer, forester, or land-use manager. NOAA, under congressional guidance, continues to operate a system of weather satellites, but turned Landsat over to a private corporation, EOSat. However, with potential commercial revenues only a small fraction of its operating costs, the business is not presently viable and its future is cloudy.

NOAA's weather satellite program is inadequate in both coverage and technology. EOSat is not commercially viable and Landsat is inferior in resolution to the European Spot Satellite. The U.S. has no program at all to develop radar satellites for civil applications. Meanwhile, Europe, Japan, and Canada all have advanced technology remote sensing satellites, including radar satellites, under development, currently being built, or prepared for launch.

Interagency management has also been a problem for applications satellites. For example: there seems to be inadequate cooperation between NASA and the Department of Defense (DOD) on ACTS and Milstar (the military communications satellite); there is duplication between the NOAA meteorological satellite program and the Defense equivalent; and, the Navy canceled the oceanographic satellite intended to carry the NASA scatterometer radar and failed to follow-up the loss of Seasat with a continuing satellite program. Our country cannot afford to continue this poor cooperation between NASA, NOAA, the Department of Commerce and the DOD. Stronger mechanisms are required to address this critical problem.

More generally, over the years, NASA's programs have generated and demonstrated a great amount of highly advanced, sophisticated technology in putting man in space and in exploring the planets. Yet, in spite of NASA's twenty year old technology transfer program, the United States today lags behind Japan and other countries in many critical, commercially-important technologies, some in the very fields in which NASA has been deeply involved.

IEEE-USA believes this anomalous situation exists in large part because the NASA technology transfer process has not worked to the degree that it must. We believe both the proposed NASA budget and the Augustine report have overlooked this program and the corresponding opportunity for commercially important contributions to our Nation's economic competitiveness, contributions which would help justify NASA's space program and also support continued U.S technological leadership.

In our opinion, both the proposed NASA budget and the Augustine report fail to adequately address several particularly significant civil space issues:

(1) The unit costs of space assets and infrastructure continue to be enormous and, unless reduced, will burden the taxpayer inordinately and stifle entreprenurial business activities;

(2) The U.S. needs new, useful, and affordable space goals, designed to assist our economic competitiveness;

(3) Increased attention should be given to space applications--the use of space technology and systems for practical benefit; and

(4) More emphasis should be given to space technology, not just to facilitate NASA operations but also to maintain and enhance U.S. aerospace leadership.

To help resolve these issues, IEEE-USA suggests two sets of actions for your consideration:

(1) Congress should formulate policy and set goals for the United States in developing space applications, and correspondingly reorganize elements of NASA, NOAA, and the Departments of Commerce and Transportation to pursue those goals in alliance with U.S. industry. Simultaneously, Congress should encourage mutually-beneficial international cooperation in civil space applications.

(2) Congress should formulate policy and set goals for the United States with regard to the role of NASA and its space program in enhancing U.S. technological leadership, giving particular emphasis to the transfer of NASA-supported space technology into the U.S. private sector.

We believe aggressive action in these two areas, if carried out cooperatively with industry, would do much to increase our national return on space investment and shore-up flagging public support of our space program while advancing U.S. technological leadership.

We live in extraordinary times: within the past two years Cold War tensions have greatly diminished and a war in the Persian Gulf has been fought and won. Technology played a vital role in both wars: precision guided munitions like the Patriot missile dominated the Persian Gulf battlefield; and space proved a key battleground for the Cold War, wherein the United States demonstrated the preeminence of its free-enterprise based technology. Now we confront a new sort of war: international economic competition. IEEE-USA believes that technology, particularly aerospace technology, once again will help us carry the day. That should be the objective of both the NASA program and budget.

GEORGE CURTIS SPONSLER, III

Ph.D., M.A., B.S.E., Princeton University
J.D., The George Washington University National Law Center

Chairman, Institute of Electrical and Electronic Engineers - United States Activities Aerospace R&D Policy Committee: testified before various authorization and appropriations committees of both the Senate and the House of Representatives of the U.S. Congress. Formerly Chairman, Subcommittee on Privacy of the IEEE-USA Committee on Communications and Information Policy, and Chairman of the general science and technology policy section of the American Association for the Advancement of Science.

Congressional Fellow: served Senator Paul Simon as science advisor, representating and speaking for the Senator at various congressional and national meetings. Designated as the Senator's liaison with the National Economic Commission.

Member, Science Policy Task Force: advised President Carter during his successful 1976 campaign. Developed and analyzed national technical policy issues.

Chairman, Washington, DC. foreign policy study group of the Coalition for a Democratic Majority. Developed position papers involving, inter alia, the Near East and international economic competitiveness.

President of Law, Mathematics, and Technology, Inc., a consulting company engaged in multidisciplinary policy analyses involving research and development (e.g., President Ford's six billion dollar synfuel loan-guarantee congressional proposal).

Have also served: Executive Secretary of the National Academy of Sciences' National Research Council Division of Engineering; Director of IBM Federal Systems Division's Center for Exploratory Studies; Chief Scientist and Director of Technical Analysis and Operations Research for the U.S. Navy Bureau of Ships; Liaison Officer for Electronics with the Office of Naval Research Branch Office in the U.S. Embassy, London; and Senior Staff member of the Massachusetts Institute of Technology's Lincoln Laboratory.

A resident of Montgomery County, Maryland intermittently since 1942. Member of the bars of Maryland and the District of Columbia. Since 1981, a sometimes panel member and docket attorney for the Montgomery County Public Defender.

Mr. HALL. Thank you, Dr. Sponsler.
We have David Gleich.
I recognize you at this time, Mr. Gleich.
Mr. GLEICH. Thank you.
Mr. HALL. I got it right both times then, didn't I?
Mr. GLEICH. Beautiful. Beautiful. [Laughter.]

STATEMENT OF DAVID GLEICH, CHAIRMAN, AEROSPACE DIVISION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS, WASHINGTON, DC

Mr. GLEICH. My name is David Gleich, and I appear before you today as Chairman of the Aerospace Division of the American Society of Mechanical Engineers—ASME. The Task Force on Civilian Space Policy of the Aerospace Division of the ASME is pleased to present its views on the fiscal year 1992 budget proposal for the National Aeronautics and Space Administration—NASA. This statement represents the considered judgment of the task force. ASME is a non-profit educational, scientific, and charitable organization which was founded in 1880. The ASME has 118,000 members, about 20 percent of whom are involved in aerospace activities.

Mr. Chairman and members of the subcommittee, I intend to abbreviate our written testimony, and I take note of your prior remarks that such testimony written will be part of the record.

Mr. HALL. Yes, all of your written testimony will be made part of the record. No one objects to it, obviously.

Mr. GLEICH. Thank you.

Erratic and inconsistent funding cause programmatic waste and reduced effectiveness. In our view, the Administration has proposed a realistic space program with growth approximating that represented by the Augustine report. It is the task force's hope that Congress and the Administration will provide consistent funding for these programs beginning with this budget and maintained through the end of this century.

In general, we agree with the individual programmatic increases proposed for fiscal year 1992; however, we have recommendations in specific areas.

One, we believe it is important that programs have well defined requirements, which should include realistic schedules and costs. It is recommended that fiscally achievable sub-goals—that is, technology building blocks—be scheduled that lead to specific dates for the permanently manned space station, manned mission to Mars, Mission to Planet Earth, and space exploration mission.

Two, NASA must take the lead in defining our space goals and establishing mission and implementation requirements. By and large, contractors will carry out the engineering development and equipment fabrication needed to accomplish these missions and goals. Therefore, NASA must acquire the technical and planning managers so essential to accomplish these tasks. Some of these are available within the present NASA organization.

In addition, NASA should pursue acquiring mid-career managers from the space industrial complex who have had experience in managing and developing large systems. Further, NASA must eliminate the non-value elements from its procurement and con-

tracting processes. Total quality management must be implemented at all levels of NASA administration, program, and personnel management.

Three, the task force strongly recommends additional funding for colleges and universities, which is coupled with this Nation's long term aerospace objectives. We recommend doubling individual engineering research grants, the National Space Grant College and Fellowship Program, and NASA's Summer Faculty Fellowship Program.

Four, risk management/risk assessment must become a NASA standard operating procedure. The Augustine report recommends that NASA establish a system, concept, and analysis group to provide design approach, program objective, and national goal assessments. This implementation will result in increased program effectiveness and a better use of funds.

By the year 2000, the United States will face even more adverse foreign competition for launch services. We must therefore pursue development of a new expendable launch vehicle—ELV—utilizing today's technology and many of the fundamentals associated with our Advanced Launch System—ALS—Program. This effort should be undertaken as a joint industry/Government consortium.

Five, it is absolutely crucial that the U.S. maintain a capability and schedule for launching payloads through the 1990s. Funding must support this objective. For some time, ASME's Task Force on Civilian Space Policy has advocated the need for a national civilian space policy that is responsive to the country's needs and that can be implemented within the bounds of fiscal constraints. NASA must clearly delineate such a plan to the Congress as justification for its major programs and for the continued support of critical technology development so essential to maintaining the United States' lead in technology for future space applications.

Now, this summarizes our views on NASA's fiscal 1992 program plan that we feel offers the U.S. a strong and viable space science and exploration program. We have some additional comments in our written statement on specific programs and their funding levels and offer our insights on how dollars and technology should be coupled.

Thank you, Mr. Chairman, and I will be pleased to answer any questions the committee might have.

[The prepared statement of Mr. Gleich follows:]

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Statement of the

Task Force on Civilian Space Policy of the

Aerospace Division of the

American Society of Mechanical Engineers

on the

Fiscal Year 1992 Budget Request of the

National Aeronautics and Space Administration

before the

Subcommittee on Space of the

Committee on Science, Space and Technology

U.S. House of Representatives

March 12, 1991

The Task Force on Civilian Space Policy of the Aerospace Division of the American Society of Mechanical Engineers (ASME) is pleased to present its views of the FY 1992 budget proposal for the National Aeronautics and Space Administration (NASA). This statement represents the considered judgement of the Task Force, a group of experts in the aerospace field, rather than an official position of ASME. ASME is a non-profit, educational, scientific, and charitable society founded in 1880. ASME has 118,000 members, including 19,000 students. Because of the immense variety of applications for mechanical engineering, over twenty percent of our membership is directly or indirectly involved in aerospace technologies.

For the record, the Task Force recently submitted testimony to the Committee on Science, Space and Technology regarding the Report of the Advisory Committee on the Future of the U.S. Space Program (Augustine Report), and our comments during this testimony will reflect some of our thoughts on the report as well. In reviewing the FY 1992 budget request for NASA against the recommendations of the Augustine Report, it is encouraging that many of the programmatic directions offered by the report are included, especially the new launch system initiative. Overall, the Task Force concurs with the proposed budget of $15.7 billion, which represents a 13.8 percent increase over FY 1991. We support an annual level of increase of 10 percent as the minimum for NASA, and an additional 1 percent to be spread across all programs in the budget to account for inflation as recommended by the Augustine Report. This amount is essential for a stable, well-executed space and aeronautics program that maintains our scientific and technological base.

In recent years, NASA has requested budget increases of approximately 23 percent, and these have been regularly reduced to 13 percent in the course of the budget process (see Table 1). This pattern of budget requests, followed by reductions in appropriations, has been primarily due to deficit reduction requirements and congressionally mandated program decreases. However, this process has resulted in inconsistent strategic long-term planning and caused programs to be rephased, redefined, restructured, or even halted. The Administration has proposed a realistic space program with growth approximating that recommended by the Augustine Report. It is the Task Force's hope that consistent funding for these programs can begin with this budget and be maintained through the end of this century.

TABLE I

FY NASA Budget Request versus FY Appropriations
($ Billions)

	FY 90	Increase Over Prev. FY	FY 91	Increase Over Prev. FY	FY 92	Increase Over Prev. FY
Request	$13.4	23%	$15.1	23%	$15.7	13.8%
Appropriation	$12.3	13%	$13.8	12%		

In general, the Task Force agrees with the individual programmatic increases proposed for FY 1992; however, we have recommendations in specific areas, primarily the academic programs, where minor increases could have a tremendous impact. In addition, the Task Force stresses the importance of the Aeronautical and Space Research And Development Programs where the proposed funding is critical to sustaining NASA's technological capabilities.

However, the Task Force wishes to note the following concerns, with the realization that the associated financial and programmatic issues can be accomplished only through trade-offs at best.

1. We believe it is extremely important that research programs have definitive requirements, which should include schedules and costs for example, the specific lack of a definitive schedule for manned space exploration leaves open the question of exactly what is required to accomplish the Mission from Planet Earth. We could (hypothetically) research the necessary technology until the Centennial of the Augustine Report, waiting for the command "to go."

   In addition, motivation and morale of any work force, including NASA's highly qualified team, can be difficult to maintain if accomplishments are not directly related to a specific schedule. It is recommended that a set of fiscally achievable subgoals (i.e. technology building blocks) be scheduled that lead to specific dates for a permanent manned space station, a manned mission to Mars, etc. Such scheduled subgoals must be compatible with expected fiscal restraints.

2. NASA's work force has been maintained at approximately the same strength for several years, but the range of talent has shifted, and the level of contractors has increased. Two questions which the Augustine Report posed were:

   - o how should government and support contractor responsibilities be divided; and
   - o is the current organization suitable for NASA's emerging future responsibilities?

NASA must take the lead in defining our space goals and establishing mission and implementation requirements. By enlarge, contractors will carry out the engineering development and equipment production needed to accomplish these missions and goals. Therefore, NASA must acquire the technical and planning managers so essential to accomplish these tasks. Some of these are available within the present NASA organization. In addition, NASA should pursue acquiring mid-career managers from the "space industrial" complex who have had experience managing and developing large systems. Further, NASA must eliminate the non-value elements from its bureaucratic procurement and contracting processes. Total quality management must be implemented at all levels of NASA administration, program, and personnel management.

3. The undergraduate and graduate level programs at colleges and universities are the underpinning of NASA's technical base. The Task Force strongly encourages additional funding related to increasing the available stipends and fellowships in the Graduate Student Researchers Program (from 80 to 160 fellowships at least). The most recent increase was in 1985. In addition, Congress and NASA should further stimulate student and faculty interest by:

   - o increasing support for engineering research at universities through increased individual research grants;
   - o expanding the National Space Grant College and Fellowship Program, preferably by doubling it to $24 million;
   - o doubling the NASA summer faculty fellowship program, which is operating cooperatively with the American Society for Engineering Education, from 250 to 500 fellowships.

4. Risk management/risk assessment must become one of the common tools in NASA's tool box. At each stage of the design and development of a system, reliability and safety assessments should complement the technical reviews to minimize risk. Many times these assessments, and implementation of recommendations from these assessments are precluded by schedule or funding constraints. The Task Force has noted that the Augustine Report recommends that NASA establish a Systems Concept and Analysis Group to provide design approach, program objective, and national goal assessments. The Task Force believes these activities, as ongoing review functions, should be complemented with independent engineering risk assessment/risk reduction/risk management techniques.

   By the year 2000 the United States will face even more adverse foreign competition for launch services. We must therefore consider development of a new ELV utilizing today's technology and many of the fundamentals associated with our ALS program. This should be undertaken as a joint industry–government consortium.

5. The Task Force concurs with the statement in the Augustine Report that it is highly probable that another space shuttle accident will occur. It is impossible to predict the timing of such an event, but the consequences can be assessed. Depending on the schedule, and ultimate design, of the new launch systems the U.S.'s Space Transportation System could become overly reliant on the shuttle for many years to come. It is absolutely crucial that the U.S. maintain a schedule for launching payloads through the 1990s, particularly the space stations, and that in review of the potential consequences of disruption, Congress should debate whether or not the construction of a sixth shuttle is appropriate. We are concerned that the aging of the current fleet, and the continuing insufficiency of spares could lead to significant extensions in payload launch dates through the end of the decade.

6. The Advisory Committee's recommendation to revise NASA's management structure to focus on the pursuit of civil space program goals is timely and perhaps overdue. For some time, ASME's Task Force on Civilian Space Policy has advocated the need for a "National Civilian Space Policy" that is responsive to the country's needs and that can be implemented within the bounds of realistic fiscal constraints. This policy should include the creation of an efficient management structure for NASA. The agency has been subject to criticism of its technical capability, the expense of its major civilian space projects, growth of internal bureaucracy, and the lack of a politically acceptable space program plan. NASA's goals should focus on efficient management of its major programs but not at the expense of critical technology development so essential to maintaining the United States lead in technology for future space applications. In this latter regard we are being challenged by foreign competition.

These are our major comments on NASA's FY 1992 program plan that we feel offers the U.S. a strong and viable space science and exploration program. We have some additional comments on specific programs and their funding levels, and offer our insights on how dollars and technology should be coupled.

NASA RESEARCH AND DEVELOPMENT PROGRAMS

Space Station

The Task Force notes that some of the same symptoms that affected the space shuttle are now being exhibited with the Space Station, i.e., over optimism concerning predicted capability, availability, maintainability, cost, and risk. The Task Force believes that the Space Station must

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first be a function of its research goals as revised by NASA based on the recommendations of the Augustine Report. A mission statement should be developed and agreed to by all participants in the program, including Congress and the National Space Council. To minimize risk, the Space Station development plan should:

- o proceed with the development of the hardware designs required for the man-tended facility;
- o establish a reasonable, affordable building block program which has a specific schedule and a stable funding profile with adequate reserves (referred to as management reserves by industry);
- o define the objectives, design and funding requirements for the critical closed loop life support system technologies and hardware for the permanent manned station and for life sciences and materials research. This must be done now in order to determine systems requirements, power usage, and support systems development. The design should not preclude additional components or system interfaces as new requirements are defined.

The Task Force is cognizant of the monumental engineering challenge to place a facility such as the station in the unforgiving environment of space. Unfortunately, in our view the engineering community has not been effective in conveying the technical complexities of this project to the public. We believe that public debate over the station will shortly move from "why a station" to whether it is possible at all, and at what cost. It is in this debate that the engineering community must be fully responsive and we encourage such debate. If clear performance requirements are defined, if costs are realistically estimated from the bottom up, and if sufficient testing is funded to thoroughly wring out the design in the context of appropriate risk management we believe that the public will support the program. Of course, the key to completing the job is planning to complete the job. Only consistent multiyear funding, based on the preliminary design, can assure that stability is introduced to the process; otherwise, we may be back here a year from now working with another "restructuring" euphemism. We are fully aware that requirements can evolve, and we can cope with the impact of that process, but changes must be implemented in an orderly, realistic, and stable atmosphere.

NEW LAUNCH SYSTEM

The Task Force supports the proposed New Launch System and believes that reducing the nation's dependence on the shuttle will strengthen our progress towards the reliability of launch services associated with a mixed fleet.

However, the Task Force notes that competing requirements could muddle this new effort as occurred with the shuttle and the space station. There is the obvious desire to both:

- a) design an unmanned system that lowers risk and cost to loft a variety of spacecraft, and
- b) design a man-rateable system that can serve NASA, DOD, the Space Station, and future lunar/planetary missions. This suspiciously sounds like Shuttle II, attempting to be all things to all people.

In consideration of reducing risk and utilizing current technology, the Task Force recommends that the national strategy for the new launch system rely on a shuttle derived ELV. Our major concern is that the shift of the space station hardware from the shuttle to the new launch system not delay the initial operating capability of the space station. Therefore, we recommend that a design requirement for the new launch system be the ability to support existing planned shuttle payloads, and that there should be no impact on the space shuttle progress due to the selection of the new launch system configuration. In this process, lower technology design approaches may be preferable to assure lower risk and higher design reliability. Separate studies underway in the Advanced Programs office should continue to pursue long-term concepts for advanced space systems that will ultimately replace the shuttle.

EARTH OBSERVING SYSTEM (EOS)

The 15 year, multisatellite data accumulation process known as EOS will introduce new technical challenges in terms of analysis, modelling and predicting behavior of the Earth's global processes. From an engineering standpoint, the most challenging aspect is the process of data gathering that requires the use of multiple sensors to observe the same phenomenon. This process cannot be reproduced on Earth; no suite of tests can be run using EOS-A, EOS-B, the Earth probes, UARS, and TOPEX simulations prior to launch. Therefore, it is critical that the EOS Systems be designed to supply:

a) high degrees of reliability of the data stream; and

b) the optimum method for completing the scientific objectives established for EOS.

We note that NASA has proposed to undertake an external engineering review to examine the alternatives for flying EOS instruments, and we applaud this endeavor as appropriate to the front-end systems requirements philosophy we have been advocating throughout this statement. Sufficient groundwork at the beginning of any large endeavor such as MTPE can eliminate costly mistakes and redesign at a later date.

THE NATIONAL AEROSPACE PLANE PROGRAM (NASP)

The Task Force supports the investment made in the National Aerospace Plane (NASP) Program. Hypersonics is a key technology whose aggressive development in the next decade will be essential to maintaining America's leading position in the global aerospace market. This technology, recently stimulated by timely advances in materials and computers, is now ready to be developed and used to provide a whole new generation of hypersonic flight vehicles. The NASP, jointly funded by the U.S. Air Force and NASA, along with significant investments by industry, is the spearhead and main focal point of this activity in the U.S. As a result of focusing a major portion of our national industrial, governmental, and academic capabilities on the challenging task of designing and eventually building this air-breathing single-stage-to-orbit vehicle, significant technical advances have been made in the past couple of years over our previous (1960s-based) technology base. As this critically important program continues, further significant advances can be expected to affect not just the aerospace industry but other industries as well. There will be far-reaching benefits from the use of the new high temperature, high strength, lightweight materials being developed under the NASP program, such as carbon-carbon composites, titanium aluminides, high conductivity metal matrix composites, and others. Advances are also being made in the understanding of air flows, turbulence, mixing and combustion at very high temperatures and the modelling of these phenomena using computational

fluid dynamics (CFD). New facilities to test at high Mach number conditions are being built, and advanced sensors to facilitate the measurement and understanding of complicated flow processes have undergone dramatic improvements in sophistication and utility. The capabilities developed in this program will be of great benefit not only to the next generation of aircraft, spacecraft, and missiles, but can be applied to the development of more fuel efficient cars, more compact, lower polluting power plants and chemical processing facilities, safer and more reliable engines and many other possibilities. Follow-on vehicles to the NASP offer the possibility of significantly lower cost and much greater ease of access to space. The routine use of non-polluting hydrogen fuels could also stimulate the growth of a new industrial infrastructure. We urge NASA to ensure that all of these exciting technical challenges and possibilities are communicated to our colleges and universities to inspire the next generation of engineers and scientists.

The formation of the National Team, another significant innovation of the NASP program, breaks new ground in management and cooperation on a national level. We applaud this effort to bring the nation's foremost talents and resources to bear on this program, in order to ensure the success of the program and to provide a strong, competitive industrial base capable of meeting the global economic and military challenges of the next century.

The value and importance of hypersonic technologies have not been lost on our international competitors. All countries with significant aerospace industries have and are making considerable investments in major hypersonic programs. The United States is still leading in this technology, but without the National Aerospace Plane effort that lead will be rapidly eroded, and we will lose a major advantage in the only industry that provides this nation with a significant favorable trade balance. The world knows that the hypersonic age has arrived and is appropriately making significant investments therein. The NASP program may give us the same advantage in the hypersonic age of the 21st century that the 707 provided in the jet age of the 20th century. Continuation of the NASP program is important to ensure that many tens of thousands of aerospace jobs remain in the U.S.

COMMERCIAL PROGRAMS

The Task Force has long encouraged NASA to foster increased technology transfer of its research development activities to commercial users. It is very encouraging to see Technology Utilization funding increased to continue this important task. As we noted in our introduction, we believe there are areas of NASA's budget where minor adjustments in funding could have significantly greater returns to the nation, and the Task Force believes this is one of those areas. We recommend that the committee double the funding for the Technology Utilization Division in response to the increased demands for NASA's technology transfer products and services.

Commercial development of space portends many exciting possibilities and from a systems requirements standpoint, the Task Force believes that NASA's role should continue to be that of facilitator. For example, we support the procurement of ELVs and payload modules for the shuttle that have been developed by private industry.

ACADEMIC PROGRAMS

The United States Space Program can be regarded as a doorway to the stars. That door can be closed to us if we allow the scientific, technical, and financial commitments necessary to pursue long-term, stable research and development of the space frontier to fade. The keys to keeping this door open permanently are enhancement of the engineering infrastructure of NASA,

and the resources that are invested by our nation in undergraduate and graduate engineering education in fields associated with space technology.

The Task Force supports the FY 1992 budget request for NASA's academic programs suggesting, however, that additional funds be provided for these programs. We believe that NASA has an urgent need to promote space-related academic programs in undergraduate and graduate schools to foster interest in advanced space technology. Specifically, we recommend that:

- NASA's education affairs budget, which incorporates the graduate student researchers and summer faculty fellowships, be doubled in FY 1992. The numbers currently budgeted do not keep up with inflation;

- the National Space Grant College and Fellowship Program should be expanded to $28 million in FY 1992. This program continues to broaden the base and enhance the capabilities of universities involved in space research

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DAVID GLEICH

Mr. David Gleich is Senior Vice President of the ARDE Incorporated. A Norwood, New Jersey contractor, he has had forty years of experience in the aerospace, aeronautics, nuclear and chemical processing plant fields.

Gleich is the Chairman of the Aerospace Division of the American Society of Mechanical Engineers (ASME) and also serves as a member of the Propulsion Technical Committee of that division. A member of the American Institute of Astronautics and Aeronautics (AIAA) he has served as Technical Session Chairman for the joint AIAA/ASME Propellant Feed System Tankage.

Mr. Gleich has written numerous technical publications related to aerospace hardware, structures and materials. He has a Bachelor's degree in Civil Engineering and a Master's degree in Applied Mechanics.

Mr. HALL. Thank you, Mr. Gleich.

I recognize Dr. Larson, and I thank you for summarizing, and your entire remarks will be put in the record.

STATEMENT OF DR. ARVID G. LARSON, VICE CHAIRMAN, PUBLIC AFFAIRS COUNCIL, AMERICAN ASSOCIATION OF ENGINEERING SOCIETIES, WASHINGTON, DC

Dr. LARSON. Good afternoon, Mr. Chairman.

I am here representing the American Association of Engineering Societies—or AAES. AAES represents a broad spectrum of professional engineering societies and over 600,000 engineers, including a large number working in the aerospace industry.

We are especially qualified to testify about the NASA budget today because the only direct interest that AAES has in NASA expenditures is the extent to which they contribute to a vital America, and a vital America is one that fully utilizes its engineering resources.

In a way, Mr. Chairman, I'm operating here as the wrap-up hitter with two of my colleagues. Let me first say that we are most encouraged to see a relative shift in the Administration's emphasis in the fiscal year 1992 program that is reflective of the Augustine Committee's recommendations. However, we would like to offer specific recommendations on a more significant and fundamentally necessary shift in NASA program priorities to reflect more closely today's climate.

As you know, unparalleled economic and technical restructuring of the world order since the time of Apollo have reduced America's ability to compete in world markets, and with this change, the spending priorities of the Federal Government, including NASA, must be constructed to meet the challenge. NASA can no longer establish priorities to go to Mars just because it's there. In this regard, AAES believes that NASA funding should be strengthened in the areas of addressing Earth-based challenges oriented at securing the Nation's economic standard of living and competitiveness in the technological marketplace.

In this context and with today's fiscal realities constraining our abilities to act fully on our many dreams for tomorrow, we believe NASA must increasingly continue to pursue activities that directly affect America's competitive posture. Investments in NASA in the past have paid great dividends, and the engineering community believes future NASA investments hold as much or more potential. Priorities must be realigned and programmatic tradeoffs made now to establish NASA to maximize its contribution to the technological competitiveness of America, and thus the prosperity of our Nation.

AAES believes that the benefits to developing the technologies needed to support manned missions to the mission and to the planets must be balanced against the need to apply public monies to programs that have more of an impact today. The national interest requires the Government to invest public funds in developing space applications designed to assist our Nation's economic competitiveness as well as increasing support for advanced aeronautics research and development, such as the National Aerospace Plane.

We strongly support additional emphasis on NASA's several education programs for pre-college, undergraduate, and graduate scientists and engineers. America may someday be in a better position to lead the colonization of our solar system; however, this cannot be the driving priority in the budget today.

In my written testimony, Mr. Chairman, we offer several specific suggestions for emphasis in various of the budget program areas, and these include space applications, aerospace, commercial space, Mission to Planet Earth, space science, the educational programs, and the new life systems. I'll just highlight several of these comments.

Our number one priority that we suggest for NASA is in the area of space applications. Satellite communications and space-based remote sensing of the earth have been of considerable importance to U.S. technological competitiveness and economic interest since the inception of NASA. The last decade, however, has produced a shift in NASA emphasis from these important space application opportunities. We suggest a turnaround in this emphasis in both the letter and spirit of NASA priorities for advanced satellite communications and remote sensing programs.

We've already heard my colleague, Dr. Sponsler, talk about the Advanced Communication Technology Satellite Program; I will not repeat that recommendation. AAES also urges that necessary programmatic emphasis be given to full scale test and demonstration of the ACTS potential and that this advanced, highly sophisticated technology be expeditiously transferred to U.S. industry to maintain U.S. leadership in commercial satellite communications.

Advanced technology remote sensing satellites are surely needed as well. Future meteorological satellites, oceanographic satellites, and radar mapping satellites for civil applications are needed to support U.S. industry. We urge NASA to continue developing the vision and leadership needed to meet this challenge. The NASA budget request as well as the Augustine report makes little mention of the reduced state of U.S. capabilities in these space application technologies nor acknowledges the growing international competition in space applications. AAES recommends an acceleration in all aspects of space applications as the best leveraging of our current national investment in our space programs.

Our second recommended priority is on aeronautics and the National Aerospace Plane. We believe that NASA can make great strides in American economic competitiveness by shifting money and attention to aeronautics research and development programs. Aeronautics is unique in its close relationship between industry and Government. The costs associated with aeronautics technology development are very high and, in many cases, too great for individual companies to bear alone.

NASA has provided the American aerospace industry with the R&D facilities that have enabled the United States to achieve preeminence in world markets. NASA aeronautics technology development in the 1960s and the 1970s gave U.S. industry this lead. However, to maintain this world class leadership, we suggest that NASA emphasize more aeronautics R&D than is reflected in this budget proposal, and I might say to remember the first "A" in the acronym.

In particular, the engineering community believes that insufficient attention has been given to the National Aerospace Plane as the wave of the future in air and space transportation. Similar to the revolution in communications and computing technologies made possible by earlier NASA efforts, the NASP could herald a new age of materials, transportation, and propulsion technologies.

The challenge is monumental, on the order of sending a man to the moon, but this technology will put American commercial aircraft sectors far out ahead of the competition, and the peripheral benefits are considerable. We strongly urge that NASP receive increased funding so as to keep America competitive with other nations in advanced transonic transportation research.

AAES' comments on commercial space parallel those of my colleagues, but let me say a few words about our views on space science. We do believe that space science is a vital component of the Space Program. Even with the orientation that we suggest toward space activities with tangible effect on the quality of life on Earth, space science has a critical role to play. Moreover, the cost versus scientific return of unmanned, near Earth and planetary missions is extremely low relative to manned space flight. Improvements required of the next generation of interplanetary probes are guaranteed to advance the frontiers of robotics, miniaturization, and data communications, all of which have significant implications on Earth.

We suggest that to realize these benefits NASA must increase emphasis on space science over competing manned programs. We believe the space science budget has been shortened in recent years by several high cost projects. We fully support the funding for CRAF/Cassini, the only interplanetary explorer now planned by NASA, and we call for additional unmanned projects.

My final comment on emphasis will be on education programs. The education programs of NASA in fact may return the greatest future payoff for this Nation. The 30-year history of NASA's success and stunning accomplishment, which has been the inspiration of this Nation and the world, has caused us all to look favorably on the opportunities of science and engineering. NASA initiatives, more than those of any other Federal program, can make the connection in the minds of children and young adults between study now and fulfilling awards later.

We believe that NASA must coordinate efforts with the Department of Energy, the National Science Foundation, and all other Federal math/science education programs to ensure complete coverage and maximum efficiency. We engineers know firsthand the inspiration and excitement of learning about science provided by the pictures of Americans walking on the moon or the closeup views of the rings of Saturn or all the other wonderful views that we see in this hearing room.

Many of us turned our focus to math, science, and engineering during these pioneering times in U.S. history. Not only will these programs benefit the Nation by increasing the scientific literacy of Americans and attracting more students to careers in science and engineering, but NASA will be better able to replace its technical work force, many of whom are now nearing retirement years.

NASA programs at the graduate and undergraduate level can encourage more Americans to literally reach for the stars.

In conclusion, Mr. Chairman, I wish to convey AAES' desire to work with your committee and indeed with NASA program managers. We can bring to bear the technical expertise and perspective of our 600,000 engineering professionals on the complex problems that Congress and NASA must resolve in order to make the best judgments on the direction of the U.S. Civil Space Program. We pledge ourselves to continuing mutual efforts with Congressional and NASA leadership in restoring public support of our space program while advancing U.S. technological leadership and industrial competitiveness.

On behalf of AAES, I thank the committee for allowing us to present our views to you.

[The prepared statement of Dr. Larson follows:]

AAES

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STATEMENT TO THE
SUBCOMMITTEE ON SPACE
OF THE
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

ON THE

FY 1992 NASA BUDGET AUTHORIZATION AND CIVIL AEROSPACE POLICY

BY

DR. ARVID G. LARSON, P.E.

VICE CHAIRMAN
PUBLIC AFFAIRS COUNCIL
AMERICAN ASSOCIATION OF ENGINEERING SOCIETIES

MARCH 12, 1991

STATEMENT TO THE
SUBCOMMITTEE ON SPACE
OF THE
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
UNITED STATES HOUSE OF REPRESENTATIVES

on the

FY 1992 NASA BUDGET AUTHORIZATION AND CIVIL SPACE POLICY

by

Arvid G. Larson
Vice Chairman
Public Affairs Council
American Association of Engineering Societies

Good afternoon Mr. Chairman and members of the subcommittee. My name is Arvid G. Larson and I serve as Vice Chairman of the Public Affairs Council of the American Association of Engineering Societies (AAES). I am honored to come before you to present the views of AAES on the NASA budget for FY 92. AAES represents a broad spectrum of professional technical societies and over 600,000 engineers, including a large number working in the aerospace industry. We are especially qualified to testify about the NASA budget today because the only direct interest AAES has in NASA expenditures is the extent to which they contribute to a vital America -- and a vital America is one that fully utilizes its engineering resources.

Let me first say that we are encouraged to see a relative shift in the Administration's emphasis in the FY 92 program request that is reflective of the Augustine Committee's recommendations. However, we would like to offer the following recommendations on a more significant -- and fundamentally necessary -- shift in NASA program priorities to reflect more closely today's climate. Unparalleled economic and technical restructuring of the world order since the time of Apollo have reduced America's ability to compete in global markets, and with this change the spending priorities of the federal government, including NASA, must be constructed to meet the challenge. NASA can no longer establish priorities to go to Mars just "because it's there." In this regard, AAES believes that NASA funding should be strengthened in the areas of addressing earth-based challenges, oriented at securing the nation's economic standard of living and competitiveness in the technological marketplace.

In this context and with today's fiscal realities constraining our ability to act fully on our

many dreams for tomorrow, we believe NASA must increasingly continue to pursue activities that directly affect America's competitive posture. Investments in NASA have in the past paid great dividends and the engineering community believes future NASA investments hold as much or more potential. Priorities must be aligned and programmatic trade-offs made now to enable NASA to maximize its contribution to the technological competitiveness of America, and thus the prosperity of our nation.

AAES believes that the benefits to developing the technologies needed to support manned missions to the planets must be balanced against the need to apply public monies to programs that have more of an impact today. The national interest requires the government to invest public funds in developing space applications designed to assist our nation's economic competitiveness, as well as increasing support for advanced aeronautics research and development, such as the National Aerospace Plane. We strongly support additional emphasis on NASA's several education programs for pre-college, undergraduate and graduate scientists and engineers. America will someday be in a better position to lead the colonization of our solar system. However, this cannot be the driving priority in the budget today. The following sections outline our thoughts on the role that several of NASA's program areas play toward this end.

SPACE APPLICATIONS

Satellite communications and space-based remote sensing of the earth have been of considerable importance to U.S. technological competitiveness and economic interests since the inception of NASA. The last decade, however, has produced a shift of NASA emphasis from these important space application opportunities. We suggest a turnaround in this emphasis in both the letter and spirit of NASA priorities for advanced satellite communications and remote sensing programs.

The Advanced Communications Technology Satellite (ACTS) has not received sufficient support from within NASA nor from the Office of Management and Budget. After a ten year and $500 million investment, ACTS is finally scheduled to be launched in 1992. AAES urges that necessary programmatic emphasis be given to a full-scale test and demonstration of the ACTS potential, and that this highly advanced, sophisticated technology be expeditiously transferred to U.S. industry to maintain U.S. leadership in commercial satellite communications.

Advanced technology remote sensing satellites are surely needed as well. Future meteorological satellites, oceanographic satellites, and radar mapping satellites for civil applications are needed to support U.S. industry. We urge NASA to continue developing the vision and leadership needed to meet this challenge. The NASA budget request as well as the Augustine Report makes little mention of the reduced state of U.S. capabilities in these space application technologies, nor acknowledges the growing international competition in space applications. AAES recommends an acceleration in all aspects of space applications technologies as the best leveraging of the current national investment in our space programs.

AERONAUTICS AND NASP

AAES believes that NASA can make great strides in American economic competitiveness by shifting money and attention to aeronautics research and development programs. Aeronautics is unique in its close relationship between industry and government. The costs associated with aeronautics technology development are very high and in many cases too great for individual companies to bear alone. NASA has provided the American aerospace industry with the R&D facilities that have enabled it to achieve preeminence in world markets. Is it any wonder that in the one industry in which the U.S. still holds incontrovertible advantage, a cooperative relationship exists between industry and government that closely parallels that of Japan and Europe for other advanced technologies? NASA aeronautics technology development in the sixties and seventies gave U.S. industry this lead; however, to maintain this world-class leadership, we suggest that NASA emphasize more aeronautics R&D than is reflected in this budget proposal.

The engineering community believes that insufficient attention has been given to the National Aerospace Plane (NASP) as the wave of the future in air and space transportation. In ultimate form, the NASP could replace the Shuttle as a space transportation workhorse and may well become the Boeing 707 of the 21st century. Similar to the revolution in communications and computing technologies made possible by earlier NASA efforts, the NASP could herald a new age in materials, transportation, and propulsion technologies. The challenge is monumental, on the order of sending a man to the moon, but this technology will put the American commercial aircraft sector far out ahead of the competition and the peripheral benefits are considerable. We strongly urge that NASP receive increased funding so as to keep America competitive with other nations in advanced transonic transportion research.

COMMERCIAL SPACE

AAES is encouraged to see the near doubling of funding for commercial space activities in this budget request. American companies must be given timely access to technology developed at public expense and the NASA technology utilization program is an effective element in NASA's technology transfer activities. Coupled with the new Administration policy on promoting commercial space, we believe increased funding of the technology utilization and commercial space programs has the potential to increase U.S. firms' access to our space infrastructure and technology.

No one knows the full commercial potential of space. AAES believes the best way to find out is to give entrepreneurs the opportunity to risk capital for the possibility of a corresponding return on investment. This is the American way and the driving force in our free market economy. Space, however, is too expensive a medium for all but a select few companies to take advantage of the benefits of the near-earth environment for space-based research. NASA's Centers for the Commercial Development of Space (CCDS), which bring together universities and industry to participate in such research, are giving more U.S. firms the opportunity to find a substantive niche to exploit.

Because of government procurement and disclosure requirements, as well as the unpredictability of the Shuttle flight schedule, American companies have not been as quick to invest in the CCDS concept as one might expect. All incentive to risk capital is removed by public disclosure requirements and because CCDSs must utilize available space on the Shuttle, experiments go up more infrequently than the Shuttle itself. To make CCDSs more likely to produce commercial benefits, AAES recommends Congress move the Office of Commercial Programs into a quasi-private organization, subject to Congressional and Agency oversight, but not bound by the limitations on entreprenuerialism which government now imposes.

MISSION TO PLANET EARTH

We believe the Mission-to-Planet-Earth is essential to the future of life on Earth, which is justification enough for its continuation. However, it also has the potential to change fundamentally data communications, information processing and storage, and evolve other technical benefits with commercial application. AAES is especially encouraged to see an increase of over 100% in the Earth Observation System (EOS) Data and Information System (EOSDIS) program in this year's budget. This support is essential to the management of the immense quanities of information that EOS will provide -- estimated to be equivalent to the content of one Library of Congress each week. We emphasize that continued funding and management attention are essential to ensure the most productive use of the resulting data.

SPACE SCIENCE

AAES believes that space science is a vital component of the space program. Even with the orientation we suggest toward space activities with tangible effect on the quality of life on Earth, space science has a critical role to play. Moreover, the cost versus scientific return of unmanned near-earth and planetary missions is extremely low relative to manned space flight. Improvements required of the next generation of interplanetary probes are guaranteed to advance the frontiers of robotics, miniaturization, and data communications, all of which have significant applications on Earth.

We suggest that, to realize these benefits, NASA must increase emphasis on space science over competing manned programs. We believe the space science budget has been shorted in recent years by several high-cost projects. AAES supports full funding for CRAF/CASSINI, the only interplanetary explorer now planned by NASA, and calls for additional unmanned projects.

EDUCATION PROGRAMS

The education programs of NASA may in fact return the biggest future payoff for this nation. The thirty year history of NASA success and stunning accomplishment has been the inspiration of a nation and the world. NASA initiatives, more than any other of the federal programs, can make the connection in the minds of children and young adults between study now and fulfilling rewards later. We believe that NASA must coordinate efforts with DOE, NSF and all other federal math/science education programs to ensure complete coverage and maximum efficiency.

We engineers know first hand the inspiration and excitement for learning about science provided by pictures of Americans walking on the Moon or close-up views of the rings of Saturn. Many of us turned our focus to math, science and engineering during these pioneering times in U.S. history. Not only will these programs benefit the nation by increasing the scientific literacy of Americans and attracting more students to careers in science and engineering, but NASA will be better able to replace its technical workforce, many of whom are nearing retirement years. NASA programs at the graduate and undergraduate level can encourage more Americans to, literally, reach for the stars.

NEW LAUNCH SYSTEM

AAES supports the development of a new mixed fleet launch system by NASA and DOD. Cooperation between the many arms of the federal government that receive money for space launch activities must be encouraged to increase U.S. competitiveness in an international market. Flexibility and reliability are the major attributes commercial customers seek when contracting for an expense such as this. A new launch system will do much to attract international customers to transport their payloads into space with this U.S. fleet.

A reliable space transportation system is the backbone of our space program and the Shuttle will outlive its fullest utility in the next decade. If a Shuttle-derived system is determined to be flexible enough to accommodate a wide range of payload requirements in a cost effective manner, AAES would support this approach.

SUMMARY

The National Aeronautics and Space Administration was put together in a time that did not necessarily require tangible economic justifications for the U.S. space program. Economic realities of today's world order require that our spending now be evaluated on the basis of returns to our nation's economic well-being. However, dreams define the realm of the possible and if the dreamers of NASA had not pursued their far-reaching vision, the world would be an entirely different place. The technology infusion resulting from these pursuits has revolutionized communication, transportation, and other such aspects of our everyday life. But reaching for our dreams must be done within the context of today's economic realities and AAES believes NASA can be reoriented toward accomplishing these ends.

In closing, I wish to convey AAES's desire to work with your Committee and indeed with NASA program managers. We can bring to bear the technical expertise and perspective of our 600,000 engineering professionals on the complex problems that Congress and NASA must resolve in order to make the best judgements on the direction of the U.S. civil space program. We pledge ourselves to continuing mutual efforts with Congressional and NASA leadership in restoring public support for our space program, while advancing U.S. technological leadership and industrial competitiveness. On behalf of AAES, I thank the Committee for allowing us to present our views to you.

DR. ARVID G. LARSON, P.E.

ACADEMIC BACKGROUND:

Ph.D., Electrical Engineering (Computer Science), Stanford University, 1973
M.S., Electrical Engineering, Stanford University, 1966
B.S., Electrical Engineering, Illinois Institute of Technology, 1959

PROFESSIONAL EXPERIENCE SUMMARY:

Dr. Arvid G. Larson has over 25 years of professional experience in advanced computer systems, communications and networking, signal processing, systems engineering, technology research and development, and related systems analysis within a variety of aerospace and real-time process control applications areas. Over the last decade, his experience has focused on innovative computing technology, special-purpose signal processing, and information handling applied to surveillance systems, command and control systems, undersea warfare systems, and other programs relating to advanced technology systems. Dr. Larson is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), and has been responsible for leadership and development of state-of-the-art research programs sponsored by a number of government laboratories, systems centers, and program office organizations. He has held technical and management positions with several leading technical professional services and consulting firms. Dr. Larson is currently a Research Professor at the School of Information Technology and Engineering at George Mason University and serves as Director of Small Business Programs at the University's Center of Excellence in Command, Control, Communications and Intelligence.

Dr. Larson is licensed as a Professional Engineer in the State of California and the Commonwealth of Virginia. He is quite active as a volunteer leader in the IEEE, and over the years, has been involved in a number of IEEE technical, public policy, and conference planning and management activities. He served as General Chairman of the IEEE U.S. Technology Policy Conference in 1988 and 1989, as well as participated in the leadership of the IEEE Electronics and Aerospace Systems Conference (EASCON) over the period 1981-1987. Dr. Larson is a well-known participant in many IEEE technical professional activities, and currently chairs the IEEE Technology Policy Council, consisting of over 220 volunteer members organized into seven technology R&D policy committees. In addition, he currently serves as Vice Chairman of the IEEE United States Activities Board. Dr. Larson has long been active in the American Association of Engineering Societies (AAES) and is the Vice Chair of the AAES Public Affairs Council. Dr. Larson is also active in the planning and management of several NATO Advanced Study Institutes.

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ABOUT AAES

AAES Mission

The American Association of Engineering Societies is a multidisciplinary organization of professional technical societies dedicated to advancing the practice and utilization of sound engineering in the public interest. AAES serves as a clearinghouse for communication within the engineering profession and in cooperation with its members provides technical advice on public policy issues of national interest.

AAES 1991 Priority Objectives

- Promote U.S. Economic Competitiveness on a Global Scale
- Continue Leadership Role in Coordinating and Promoting Pre-College Math and Science Education

AAES Membership

Member Societies

- American Indian Science & Engineering Society
- American Institute of Plant Engineers
- American Nuclear Society
- American Society for Engineering Education
- American Society of Civil Engineers
- American Society of Mechanical Engineers
- Institute of Electrical & Electronic Engineers
- National Institute of Ceramic Engineers
- Optical Society of America
- Society of Fire Protection Engineers
- Society of Women Engineers

Associate Societies

- American Council of Independent Laboratories
- Federation of Materials Societies
- National Action Council for Minorities in Engineering
- Operations Research Society of America

Regional Societies

- Engineering Societies of New England
- Engineering Societies of Detroit
- Engineering Societies of Tulsa
- Engineers' Society of Western Pennsylvania
- Western Society of Engineers

Mr. HALL. Thank you, Dr. Larson, and I thank the panel.
Let me get under way here.

PRIORITY OF SCIENCE IN THE SPACE PROGRAM

I suppose, Dr. Reiff, let me start with you. You've indicated some criticism of NASA's recent decisions to delete the science programs from the station, and an earlier panelist, Lori Garver, said that she didn't believe science was the overriding object of space, if I heard her correctly, and I think Dr. Sponsler said he does not support science, per se, and Dr. Larson says return to the economy is the number one priority.

How about a show of hands. Who thinks science should be NASA's number one priority?

[Show of hands.]

Mr. HALL. The vote is one to nothing, I guess. [Laughter.]

By not showing your hands, it didn't indicate that you are neutral on the matter. The other three of you believe that it is not NASA's number one priority. Is that correct?

[Nods of agreement.]

TECHNOLOGY TRANSFER

Mr. HALL. What specifically could NASA be doing or what should they be doing to improve some transfer of the technology to industry? Who wants to tie into that?

Dr. LARSON. Well, Mr. Chairman, let me——

Mr. HALL. I could have started off by asking about the cost and overruns and all that, but I'll just go right directly to the question because it's of great interest to members of this panel, I think, and to the taxpayers in general that we get that transfer to industry. It's too expensive for them to do a lot of the experimentation and the probes that we're doing now, but what could we do to hasten that or to improve that transfer?

Dr. LARSON. Well, Mr. Chairman, NASA has been synonymous with advanced technology, and much of this advanced technology has had stunning applications within U.S. industry. Speaking for the engineering community, I fear that many of the opportunities for this transfer have not been exploited as expeditiously or as effectively as one would want. There are many tradeoffs that our Nation's industrial base has to face in pursuing markets, and the impact of foreign competition in the advanced technologies has become more and more significant.

NASA has a unique relationship with the industries that support NASA—the aerospace industry, the space industry, the communication satellite industry. All are extremely important in a symbiotic relationship in pursuing the application of NASA-funded technologies into American industry, but there are barriers.

As was pointed out in the first panel, there are systemic barriers in American society to making long-term investments, to approaching high-risk projects with non-assured payoff, and we do have a culture in our business economy and perhaps in our national psyche which desires immediate gratification and assured payoff. It's very difficult, as a businessman, which I've been, to convince one's management to make long-term investments where the

payoff is not assured. So NASA is fighting a systemic problem in attempting to transfer its technology.

NASA does have a technology transfer program, and it's prided itself on its ability to transfer technology through its history.

Mr. HALL. NASA has an awful lot of programs, and without criticizing NASA, which I don't intend to do, it seems just from a view at this stage that NASA has so many great ideas and cranks so many things into the computer that they have trouble getting something with some definiteness out of the computer. How do you handle that, and how are we ever going to get it transferred to industry if we do that?

Dr. LARSON. Well, Mr. Chairman, in our testimony today I talked about the needs of using NASA resources and orienting NASA's focus toward the economic and technological challenges that our Nation faces. NASA has a unique opportunity to do that because they have some of the best resources in the world, and——

Mr. HALL. They have to do it if it's going to be done.

Dr. LARSON. They have to do it. There's no one else who's going to do it. And I would urge NASA to improve its ability to effectively transfer technology. So often it is the second or third order problem that NASA program managers face. It's not their first priority, and possibly it should be looked at as a first priority in the technology infusion to American industry through the established technology transfer processes that NASA does have in place. It could be a lot more effective and should be emphasized.

Mr. HALL. I think Dr. Sponsler is moving around and wants to say something about that.

I recognize you, Dr. Sponsler, for any comments.

Dr. SPONSLER. Thank you, Mr. Chairman.

I think there's a basic philosophical problem which we have to confront as a Nation, the Government particularly, and that is an aversion to industrial planning. You know, there seems to be a feeling that if there is any alliance between the Government and private industry and universities there must be something wrong, and I think that's wrong in itself. I think the reason the Japanese have done so well is that they, through industry organizations like MITI, have made an alliance, a very highly effective and working alliance, between the Government and industry and universities, which we don't seem able to do.

We have a philosophy—it goes back to my concern about science. We have a philosophy that we can go and look at basic research and so-called generic technology, but as soon as it gets into the applied area, that's not for the Government to worry about. And this is the problem I think we've seen in NASA. When they get a good communication satellite and a good Earth Observation System, when it gets to the point of operational effectiveness, they have to wash their hands of it, and it's passed off, and no one picks it up.

And so I think what we have to do with it is a new approach to planning for these operations in which we bring industry and universities into the initial planning process, not just wait until NASA has done something, but bring them in and help point out areas which are promising. Emphasize those and plan actually to hand off these devices, not just hope someone will pick them up. It's a philosophical problem, and it's very deep, and I don't really know

how you change it, but unless we do, I think we're always going to be running second place to countries that can do that, namely Germany and Japan.

Cost Overruns

Mr. Hall. I think another thing that they've got to solve is their consistent underestimation of the technical risk and the problem cost. I don't know of—has there ever been a NASA program that didn't spawn a cost overrun? If there has been, it's small, I think. Am I not correct in that?

Dr. Sponsler. I believe you're correct, and it's not just NASA. There was a study of DOD, I believe I recall, which was—

Mr. Hall. Well, Congress has perfected it.

Dr. Sponsler. Congress has perfected it, but I think actually the problem is that people adopt a very optimistic view of the cost of projects, very large projects, and you can understand that. I mean, they're competitive. They have to come in with a reasonable value. But unless we take more reasonable approaches to cost and unless we're willing to undertake the risk—and that really, I think, is a job for Government. Big cost and high risk areas, that is Government. After you've proven that they're economically feasible and technically feasible, then pass them off to industry.

Mr. Hall. Those overestimations were basically with the space missions really that I'm thinking about, and that really has had a negative impact on funds available for other NASA programs. You know, the question is what leads to such an underestimation, and how can we avoid it? What can we do to avoid it? How can we be a little more realistic?

Dr. Reiff.

Dr. Reiff. Well, I'd like to disagree with the statement that all missions overrun. The spacecraft that I've been working on for the last 10 years, Dynamics Explorer, was an explorer line. It was a $50 million program, and came in right on budget. We had two spacecraft, and we've collected data for nine years. This is a mission that was a robotic mission, it was an unmanned mission, and it did extremely good science for an extremely small amount of money.

I want to kind of deflect a little bit the view that science and technology are at odds with each other. I think science and technology have to go hand in hand. Advances in one lead to advances in the other, and it's not a question of how nice toys we're going to have at the end of the century but rather what we're going to do with these toys. Why are we developing these technologies?

I'm not saying technology is bad, believe me, and I think there's no better example of this partnership than with the recent problems with the Magellan spacecraft and Hubble. Computers either on board or on the ground have led to salvaging the science from what could have been major tragedies, particularly the Magellan, and it finally phoned home. But in contrast, the Russian Phobos mission had two spacecraft that were completely lost.

And the point is that we do need to work together. We're not at odds with each other. Eighty percent of the NASA budget doesn't go to science, and we're just trying to say that the science is key.

And I agree with you that there perhaps is not as much stress in the technology transfer area, and it should be something that's looked at, but the reason we go into space is because man has a goal, has a need to know.

And I think when you look at what really sparks the fourth-graders that I've spoken to, you know, they're not interested in details of the technology. They want to learn what's on Jupiter and what makes Saturn's rings and what the Great Red Spot is. They want to know what we've learned from the universe, and that's the kind of thing that sparks the kids to go into science. And then once they get into science, then the good fairy is going to turn them into engineers, and we're all happy. [Laughter.]

Mr. HALL. Well, I think before I turn it over to Mr. Volkmer—

Mr. VOLKMER. I have no questions.

Mr. HALL. No questions? Well, I won't turn it over, then.

Mr. Volkmer is the former chairman of this subcommittee and kind of my mentor, and I wanted him to see how good I was doing is the reason I hadn't turned it over to him earlier.

Mr. VOLKMER. You're doing fine.

Mr. HALL. I guess I was talking about moderate and major space missions, and I really—you mentioned the telescope, estimated cost of $300 million and it cost $2 billion. You know, those are the things that the public recognizes and remembers more so than some of the moderate or lesser expensive thrusts into space that are cost effective and don't spawn cost overruns. So I'm sure we have some of them, and I think it's good to have it on the record that you know of at least one that didn't.

Dr. Sponsler.

Dr. SPONSLER. I think the problem really lies in the large programs, basically. I don't want my remarks taken to decry these marvelous photographs of the planets. That, to my mind, is superb and to be congratulated. I look upon science as a facade to explain manned space science, for example. Why should we go to Mars or why do we go to the moon? The only explanation people can give is because we want to know what's there. It's like the mountain. Why do you climb the mountain? Because it's there. There's nothing wrong with that. It's just is it worth, you know, a better part of a trillion dollars? I somehow doubt that it is. I like unmanned spacecraft to do that. That's much better.

But I think the real problem on cost overruns is in the large programs. I mean, take Space Station Freedom. Originally, it came in at less than $8 billion, and then went up to $12 billion, and then $15 billion, then finally $30 billion, and finally Congress said, "Whoa, this is getting out of hand." I don't know where it is now, but I suspect it won't be too much less, but that's not alone in space.

I mean, look at the superconducting super collider. That's more than tripled in cost. Almost any large system. No one really knows what it's going to cost, and so they come in rather optimistically and bid low.

And, yes, Dr. Reiff——

Mr. HALL. You should go to the Astrodome down there, and remember what the judge said it was going to cost initially and what it wound up costing to build it, or to the—what's that thing in Aus-

tralia in the Sydney Harbor there? The Opera House. It started off at, what, $5 million or $6 million and cost $119 million or $120 million.

Dr. SPONSLER. We have the same problem in the Metro subway system in our own city, for example. I mean, I can't think of one large scientific technical project which has come in on budget.

Mr. HALL. The largest bank building in New York City.

Dr. SPONSLER. Precisely.

HUMAN EXPLORATION PROGRAMS

Mr. HALL. Because they had done their pilings, I think, and they didn't go through a cantilevered shell there, and then when they did get ready to build it, they did have to go through that shell, and they just found a bottomless pit, and I'm told they spent more money on the foundation there than their estimate was almost for the structure.

So I think we have to accept some estimates to go awry in anything as gigantic and as unknown and with the investigations that we have in space. You know, for Hubble to have that—I don't know how to say it, but something wrong with one of its eyes—stigmatism? Is that a good way to describe it? It is just dang near unforgivable, you know, as hard and as much as we scratch for money for science and for the program that you're here testifying for.

I guess—let's talk about human exploration. How can we structure that in the current budgetary environment, and what are your ideas on that?

Dr. Sponsler. You opened the subject a moment ago.

Dr. SPONSLER. Yes. My own personal position and that of IEEE is that we need a better balance between the Manned Space Program and the Unmanned Applications Program. In the past, the Space Program has just sopped up money from the applications area. You look where the money came from for manned activities, and it came almost exclusively, even from a little bit of science—space probes—but mostly from the applications area.

And so our concern is that we don't stop manned space. It's exciting. Everyone loves to watch man step on the moon. I mean, I'm not decrying that for one minute. I'm merely saying that we should try and have a balance between applications in space and what you might call the exploration activities in space.

Now, I don't really know. That's a judgment I think only Congress can make. What is an appropriate level for the Manned Space Program? I think it probably is too high at the moment, but I don't recommend we clean it out.

I would support, by the way, the suggestion of my colleague, Dr. Larson, that you ought to consider looking at the NASP Program more thoroughly. I mean, the real problem with manned space has been the shuttle. It's never really performed according to what it was advertised. It's never launched more than six times a year, it's had one problem after another. I think ultimately you're going to have to look at a replacement for that, and the NASP might well offer that.

Flexibility in the NASA Budgetary Process

Dr. Hall. Do you think NASA needs more flexibility in its budgetary process or less?

Dr. Sponsler. Well, that depends on whether you're talking about multi-year funding or not. I would support multi-year funding, yes. But I feel that you have to make—Congress has to play a very large role in deciding what those multi-year funds are going to be placed upon. I wouldn't give NASA an open budget and say, "Here, you have $50 billion, do with it as you like." I think your role in Congress should be, "Here's how you should spend it in the areas that we support. Now, go ahead, and we'll fund you whatever mechanism you can find for multi-year funding."

Mr. Hall. Anybody else?

Dr. Larson.

Dr. Larson. Yes, Mr. Chairman, I'd like to also remark that in considering manned space programs, one has to consider the public relations potential of this and its exploitation for that purpose by the agency, which one cannot disregard. It's important, I think, for the national well-being, to feel good about ourselves as we have in the last several weeks. It was proud to be an American when we landed on the moon. There's no doubt about that.

But I'd also like to draw the balance between where science research and development actually comes from in the NASA budget, and it's basically from the unmanned aspects. For both the unmanned and the manned programs, there's another whole area of research and development: engineering research and development. And this is where NASA has the greatest ability to help America right now in the end of the 20th century, where we stand in a world economy where we are not number one in so many critical advanced technology areas or we are losing our place.

The engineering research and development and materials and propulsion technologies and communications, computers—all of these areas which have a commercial interest and competitive interest across the board for American industry competing in this world economy can be supported by NASA, and this is whether they're manned programs or unmanned programs, but many of the activities of NASA could be enhanced toward the end of providing engineering R&D by concentrating on the aeronautics programs, such as the National Aerospace Plane.

Mr. Hall. Do you think that the Challenger tragedy caused us to be a little too cautious? There's a former astronaut and a member of the other body, and I think I read something in the paper recently where he said that back in the good old days they wouldn't have pushed back the other day when they had a minute crack in one of the doors. Do you have anything to say to that?

Dr. Larson. Let me just say I was recently at the Canaveral Launch Center——

Mr. Hall. It depends on who's going to strap to that thing, isn't it? [Laughter.]

Dr. Larson.—and I looked at two of the space shuttles that were there, and they're certainly fragile objects, and I would feel if I were in one, I'd certainly want to know there weren't cracks in the doors. Why NASA has cracks in the doors should be the subject of

the investigation, and I'm sure it is. NASA has had to run at the outer boundaries of its ability to design and develop just because of funding realities and trying to do so much in its many programs that really it has trouble focusing on an excellent overall program, a long term, long range program, in almost any of these areas.

We're talking about multi-year programs almost by definition when one talks about space programs. The uncertainty of funding, the variations in public opinion and Congressional leadership, as well as the Administration changes that go through these multi-year programs make it very difficult to structure a well thought out program.

You heard my colleague talk about the Japanese. The vertical structured Japanese consortia that address the American television market or the American automobile market are two- or three-decade type activities that have been very successful in their intrusion upon the American order, and they're gaining the competitive advantage over America.

The payoff to a multi-year assured funding is important, and I think here, too, we must remember that NASA program managers have to program and prioritize in the reality of the funds which are available, which is a difficult challenge for them.

Mr. HALL. Dr. Reiff.

Dr. REIFF. With regard to the Manned Space Program, I agree with my colleagues that certainly unmanned missions are by no uncertain terms the most cost-effective way of getting scientific payoff per dollar, but I also agree with the statement that it does peak the public's interest. And again, going back to that fourth-grader, how many people who are engineers today got excited during the time of Apollo and chose a science or engineering career because of those exciting times? I even did my Ph.D. research on an instrument that was placed on the moon on Apollo, and we could have done that same science on a free-flyer a lot cheaper, but we were there, and we did the science while we were there.

Looking at the lunar base, there is some exciting science that you can do from a lunar base that you can't do from a free-flyer. A low frequency radio array, for example. The Earth's ionosphere blocks out low frequency radio from reaching the earth, and yet you want a big receiver so that you can get good pointing to look at radio stars. So this is something that can be done on the lunar surface. There are other similar experimental platforms that you can use on the moon. Things that need large aperture of big gamma ray telescopes or such on the moon.

So I think we can think of the moon base as being sort of our next generation of great observatory, but the question is when? Do we do it in 10 years at horrible cost, or do we stretch it out and make it a sensible program? And I think that's, again, something that science has—the Congress has to decide, and I agree with the Augustine Commission's report that it should be a go-as-you-pay situation. If we go, then we should do the science that makes sense to do at the time.

Mr. HALL. Do you want to say something, Dr. Sponsler.

Dr. SPONSLER. Yes, sir, Mr. Chairman. I'd just like to suggest that as these projects and programs become so much more expensive that all the more reason there is to look to international sup-

port and international cooperation. I suggest that, for example, a moon base might come much more rapidly where we could do it conjointly with our international friends. Same thing with a mission to Mars, if we're going to do that. I think much more should be done in big science on a cooperative international basis in our own economic self-interest.

The CRAF Program

Mr. Hall. To get back to Dr. Reiff, you've been doing work on—is it the CRAF Program? And you've had some technical problems that they've been encountering. Do you want to—I have just two more questions, but do you want to briefly discuss that? And you might also tell us what might happen or how much would be wasted or what would be lost if CRAF happened to get cancelled.

Dr. Reiff. Oh, boy, I sure would hate to see CRAF get cancelled. The main problem with CRAF/Cassini is, unlike some of these missions that we are so wont to quote, both of them were budget capped, and it was clear that if they ran over, they'd go, and the first one to go would be CRAF. And so it certainly made all of us who are CRAF scientists very nervous that if Cassini ran over that CRAF would be lost. And what happened with the penetrator, again, a technologically very difficult problem, the penetrator costs went up, and so rather than cancel the whole program, we cancelled the penetrator, and I think it's still within a budget envelope, and I think it can still go and still return really terrific data.

We flew—I say "we"—the United States didn't even go to Halley, of course, because of money. That was a fly-by that occurred at 72 kilometers per second, and so the amount of data that was taken was in minutes rather than in the years what CRAF would allow us to catch up with a comet and really see a piece of the early solar system and stay with it for several years.

I think budgets and schedules and the lack of a launch vehicle has meant shifting things, and we may go to a different comet than we originally thought, but I still think the goal of going into orbit around a comet and learning the plasma physics, watching it turn on from being a dead asteroid to being a gaseous emitter to being a full-fledged comet, is something that is extremely exciting and would be our first detailed view of that kind of a body.

So I think the remaining technological challenges certainly can be handled pretty well, and the team has been extremely cohesive about cutting costs, and when things overrun, we've scaled back because we know it's a constrained mission.

Impact of Space Station Restructuring on Science

Mr. Hall. I think I even noticed in your testimony or heard you speak somewhere one time—what would be your recommendations about the science payloads that were deleted from the station? Just generally address that, and you opened about the launch system, and I want to ask that question, but the most important third question I have is important to me that I'll get to is the last question to you. But just discuss if you would the deletions, and what are your recommendations on that?

Dr. REIFF. Well, the problem with the station is when it got scaled back, and rightfully so for money purposes, they lost about half of its laboratory space. We had— essentially, all the space physics instruments were completely removed. We had one that would tow a great big magnet in space and basically create a little magnetosphere and study— it turns out having your own magnetic field might turn out to be a useful way of protecting manned missions, for example. We lost that completely.

The life science people, although they remain on the station, are concerned that with only a four-man crew, that there's not going to be enough tending to get as much science out as they would like. There's also a concern that the physical space on the station where microgravity truly exists is small, and it might be a variable if people walked around and the microgravity lab suddenly moved by three or four meters, and it's small to begin with.

So there's certainly a lot of concern that as it has been redeveloped, its capability of doing good science has decayed, and so a number of people who were not opposed to the station previously are certainly becoming more on that side. They think that scientifically it is not as useful a facility as we would like, and so as far as science priorities go, we might think about putting the money elsewhere.

Mr. HALL. You're not as excited about it as you were under the original configuration?

Dr. REIFF. Basically, yes. I think the original configuration was too expensive, and so I think scaling back was important.

Mr. HALL. I don't think I've seen the—have we seen those drawings yet? Maybe you've seen something I haven't seen, but you've just heard described the changes, and that's what you base it on. I guess we still get to open the envelope on just what it looks like.

I think—we talked about the launch system. This is my next to last question, and I'll ask Dr. Larson what you think the role of the new launch system should be and what we really use it for. That's going to be a big field, too, the new launch system and what type and how and when. And the when about as important as any of it.

ROLE OF THE NEW LAUNCH SYSTEM

Dr. LARSON. Yes. Well, Mr. Chairman, launching payloads into space is a business, and the U.S., of course, had the dominance in that business. We are losing that dominance partly because of the unavailability of the shuttle, the unpredictability of its availability, also because there are alternatives for U.S. industry, and alternatives range from the European friends and even the Chinese are launching U.S. payloads or plan to launch a U.S. payload.

The major attribute that commercial customers want of space launch vehicles is dependability and assured cost, and this new initiative between NASA and DOD I think we applaud because I think it will give us a chance to remain competitive in this area, which is very important. So we would like to see continued progress toward developing an alternative toward the shuttle for assured commercial purposes.

Mr. HALL. Does anyone else want to comment on that?

Dr. Sponsler.

Dr. SPONSLER. Mr. Chairman, I think there have been two great errors in NASA's planning with regard to the shuttle and the space station, and they're related. The shuttle error was the decision to abandon unmanned lift vehicles in favor of a manned one, merely, I think, as an excuse to support the shuttle, and I think it was a great error. The second error was the decision to make the space station without first deciding what you wanted it for. The decision was made we will have a space station, and then they began looking for what the purpose should be, and the problem is we've never really found that purpose.

And the two interact because the space station affects the shuttle. The shuttle altitude was determined by the altitude of the space station. I think really if you're going to have a space station, it should be at a higher altitude, but it can't be if we're going to use the shuttle. The two interact, and they really go back to the problem of planning. I think NASA's big problem has been planning.

Mr. HALL. Okay. I guess we've gone into this before, but the space station, as I understood it, we're to try to begin it in 1995 and finish it by 1999? Am I correct on that? I think I am. And yet the heavy launch vehicle is not deliverable, as I understand it, until September of 1999. So we didn't get to use that in building the space station, and it's too early for the moon and Mars program, which is not until 2010.

So I don't know how much sense it makes to do that heavy launch. It's too late for the space station and too early for the moon. Why build it in 1999? Why not do it earlier? Why not get after it now where we can use it in the building of the space station? Other than the cost, which I understand is about $12 billion to develop, but if we're going to build it we might as well build it for something we can use it for.

Dr. SPONSLER. We in the IEEE, of course, are not specialists on either space stations or on launch vehicles——

Mr. HALL. No, but you're smarter than I am.

Dr. SPONSLER. I'm not sure of that, sir. But I would say that the problem with the unmanned launch vehicle is that it's going to take a number of years, and probably even if you started today it probably wouldn't be ready before 1999, and if you want to have a space station by that date, you're going to have to use the shuttle. And once again, you see, the space station——

Mr. HALL. How about Saturn?

Dr. SPONSLER. Well, the problem with Saturn is that although they now claim they have found the plans, the equipment for manufacturing has been discarded, and so it would take a very long time to reestablish the production line. So it's iffy for Saturn.

Mr. HALL. If they had the plans and had the equipment, it would make some sense, though.

Dr. SPONSLER. It would make a great deal of sense. In fact, I think the error, as I said before, was in abandoning Saturn in the first place. But it's done, you know, and how do you recover from that? I don't know.

Mr. HALL. Well, you're the witness. You're supposed to be telling me. [Laughter.]

Dr. SPONSLER. I'm sorry, Mr. Chairman. I concede your point, but I have no answer.

Mr. HALL. I had a professor one time that they had stolen the quizzes and they had a gouge on it, you know, everybody had the answers, and the professor came in and said, "You think you're smart because you've stolen the question. It won't help you any at all. I've changed the answers."[Laughter.]

So maybe we get several series of answers on this.

Mr. Volkmer, have you developed any questions that you want to ask?

Mr. VOLKMER. No, no questions.

U.S. EXPERIMENTATION ON MIR

Mr. HALL. Let me ask a question that's important to me. I'm new here, and not new on the committee, but I'm finding out how little I've learned in the last 10 years being a member of the subcommittee, but I have some real hopes and desires and ambitions for the Space Program, and a lot of them are built around finding some answers in the medical field.

I had thought about using MIR to do some work, produce pharmaceuticals or crystals or whatever in a quantity that you can do you up there. The only one that's really expressed yea or nay is Congressman Rhodes, and he says he doesn't think it's too good an idea, so I haven't polled or gone down the line with the rest of the committee, but I'm very interested in it, and there are other reasons for it. Some people have national defense reasons for wanting to go ahead, some want to use the platform to get the creaks and the problems out of our own problem and decide just what do we want to build and what configuration do we want and how much science do we want on it and how should we use it.

The only thing I find against it other than that we'd have to go to the MIR on their vehicle and ours wouldn't fit up there, there's no pad for it, and there's a different inclination, and there's a lot of problems—we've got only problems as to why we can't use it and no real good reasons as to why we could but a lot of good reasons as to why we should. But if you were me and you were interested in pursuing that and even renewing the electrophoresis thrust at McDonnell-Douglas, Johnson & Johnson, and others had, how would you do it? If you were me, interested in that.

Do you have any suggestions on it? You all don't tell me you all are with Congressman Rhodes.

Dr. SPONSLER. I was hoping that Dr. Reiff would answer that question because it's basically a science question, I think, defining science being the acquisition of new knowledge. But while she's thinking about it, let me put my foot in.

Mr. HALL. All right.

Dr. SPONSLER. And that is I feel that it makes a great deal of sense to try and make use of the Russian manned space station. The problem is the compatibility of the data and the control of the experiment. I think it's fairly true that the United States is ahead of Russia in most areas of science and technology—not all, but most—and it may well be that the quality of the data which they currently have on MIR and other space stations would not be ade-

quate for our purposes. This is the argument which I hear again and again from people who want to make their own space station is you just can't take their data and use it. I think there's a great deal of truth to that, but we could make use of the platform in the future.

This would be part of the international program which I suggested earlier on. I think it would be very desirable, particularly in this area of detente, if we can call it that now, if we could do something jointly with the Russians, and the space platform, I think, in life sciences is the place where that should be. But if you do, then why do your own space platform? There's another alternative—

Mr. HALL. Well, it may tell us that we don't want to do our own space platform. But why can't we build instrumentation or equipment that can go on MIR?

Dr. SPONSLER. Oh, we could. There's no question about that. The problem is there's a certain amount of concern about the secrecy of the technologies involved. We don't like to disclose——

Mr. HALL. Well, the French and the Germans have used it. They haven't——

Dr. SPONSLER. Oh, certainly. I think that our concern, though, is with the export of technology from that aspect. There is another alternative——

Mr. HALL. We're trying to use their breakthrough, and we're afraid they're going to steal our technology?

Dr. SPONSLER. Well, it would be sort of a blow to our national pride, I think.

Mr. HALL. Now you've hit on it. That's it. [Laughter.]

It would certainly be a boost to our national acclaim for this program if they would go in and have some medical breakthroughs there that I believe, based on testimony from witnesses such as yourself, is attainable and is possible.

I'll repeat what I've been told, and I don't think anyone has denied it that's testified and that's in the know, that they have produced pharmaceuticals in quantity that might have been a breakthrough to solve the riddle of about 68 percent of the types of diabetes, and they had the bacterial attacked on it when they got it back down to Earth, and then we had the tragedy, and then we've not been back on that program since.

I'd like to see us get back on that program. If that's true, if that's 10 percent true, it's worth pursuing. And it's just a personal goal of mine. I may never gain it, but I'm going to keep hacking away at it just as long as I can.

Mr. GLEICH. I just want to make one point. It's been discussed by other speakers that the instrumentation isn't quite sufficient or sophisticated enough to pick up reliable data, but there are two reliable data points that the Russians have which are sort of independent of that. The first is they know the condition of the human animals prior to the stay in space, and they know the condition of the human animals when they came back down. Now, those are two very reliable data points.

The same thing could be said for the crystals you just discussed, and so I think that they certainly are data points that are very worthwhile to explore.

Mr. HALL. And how do you explore them to the front gate? That's what I'm trying to get to, the front gate.

Mr. GLEICH. Well, I think that would take some accommodations between people and nations. I think it's a people problem rather than a scientific problem.

Mr. HALL. Well, you know, why shouldn't we buy some technology from the Russians or why shouldn't we trade? We get about as much as we give, and we don't want to buy any of their SCUDs. We don't want any of them. We know—wasn't it General Powell that said, "They didn't miss a single one of our Patriots"? They're very accurate. [Laughter.]

Mr. GLEICH. I have no objection to trading, as long as——

Mr. HALL. But we're going to get some money to them some way. Lend-lease or however, we're going to help Russia. It's to our interest that they survive. Why not trade them for something that really and truly would help the American people and not give them anything but trade them something?

Mr. GLEICH. That's perfectly logical to me.

Mr. HALL. They're not going to trade any national defense to us, but they would trade something to us in the medical field.

Dr. Larson, you're going to help me, I believe.

Dr. LARSON. Well, no, Mr. Chairman, I certainly share your goals, and I can't specifically address the issues with the MIR space station, but I should point out that there is a considerable linkage between advances in medical technology and prior funding that NASA has received and will receive in the future, and in areas of microminiaturization, replacement body parts, new materials, diagnostic technology, systems reliability for implanted pacemakers and such all have derivations from earlier investments in the Space Program, and I think we'll see this continue.

So there is a medical value also to continuing the support of NASA. However, one may have to choose in dealing with the real issues of budget limitations and the fact that the U.S. and the Soviets might be partners in future space explorations just because of the shortfalls in both economies.

Mr. HALL. Dr. Reiff.

Dr. REIFF. I will say that my colleagues in the life sciences already are working with the Russians as far as their data on the effects of man on extended space missions. There certainly is a lot of cooperation already existing in that field.

I think one of the really farsighted design of MIR is that it was a modular system. It grew as they had the money to grow it. You add on another component. And there's been a proposal from UCAR to take the fuel tanks that we now let burn up and do something with them. I mean, we could actually think of a pretty cheap way we could build our own MIR equivalent by using old fuel tanks and sending up a framework and putting it together that way.

The difficulty with that kind of a system, and it may well be why we want to do our own, is that for some of this micrography actually you do 10 to the minus 6 G, and so you need a well known envelope of the mass distribution of your station itself, and if you want to do the really precise pharmaceuticals on both the crystal growth and also the membrane is something that I think has a lot of possibility.

But none of my life science people are going to say there's 100 percent chance of doing it in space even if we did it in our own station, but I think there is a good chance that there will be some breakthroughs, and again, if we're going to be there anyway, let's do it right.

Dr. LARSON. Mr. Chairman, I might add at one of our press briefings last year one of your colleagues, Congressman Green of New York, did make the proposal that NASA consider using the fuel tankage in space as a cheap skylab, as we did 20 or 25 years ago in the skylab program then.

Mr. HALL. Well, there's going to be renewed, I think, effort by the White House for SDI and probably with a better platform to spring from after seeing the success of the technology on the desert over there because it gave Americans a good feeling to graphically see that missile coming and something we had go up and intercept it, and then we all realized then that all the money that that hard-headed Ronald Reagan had urged us to spend on technology through the 1980s has come home to us and protected our kids. It's going to make it a little easier for him to sell SDI, and in that I'm going to try to hitch a ride on that for this medical thrust, too, so if you think of anything that can help me a little bit on that, I sure would appreciate it.

I don't suppose there are any other members that have anything that they want to say or offer or any questions. We even got rid of Volkmer.

But I really do thank you for your input and for your life's work and for the training and the dedication, the long nights and years of developing the knowledge that you have, and I thank you for coming and sharing it with this subcommittee and with this Congress.

With that, we are adjourned.

[Whereupon, at 4:22 p.m., the subcommittee adjourned, to reconvene at the call of the Chair.]

1992 NASA AUTHORIZATION

WEDNESDAY, MARCH 13, 1991

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON SPACE,
Washington, DC.

The subcommittee met, pursuant to notice, at 1:30 p.m., in room 2325, Rayburn House Office Building, Hon. Ralph M. Hall (chairman of the subcommittee) presiding.

Mr. HALL. We'll get underway. Good afternoon. I'd like to welcome all of you to the subcommittee's fourth hearing on the fiscal year 1992 NASA request. Today we will review the space-related programs of the Office of Aeronautics, Exploration and Technology.

While this office doesn't account for an extremely large share of the NASA budget, we certainly should not minimize its importance. It has a very heavy responsibility, as it's the keeper of the agency's technological "seed corn"; the source of the technology developments that make future missions possible, help keep America a leader in space, and provide benefits right back here on Earth. They are very, very important.

Just as it is important for industry to spend on R&D, if it is to remain competitive over the long term, NASA needs to invest in the future through technology. Unfortunately, it's often hard to adopt a long-range perspective when we're faced with immediate budgetary difficulties. While we don't want to waste money needlessly on misguided "hobby shop" efforts, we do think a strong, but disciplined, NASA R&D effort is in the Nation's interests.

The Office of Aeronautics, Exploration and Technology also is—as its name suggests—the focus of NASA's human exploration activities. We want to find out today how NASA proposes to conduct its exploration program in the wake of the Augustine Committee's recommendations and on the eve of the Synthesis Group's report. We hope that NASA's plans will prove to be innovative, flexible, and fiscally responsible.

[The prepared opening statement of Mr. Hall follows:]

45-073 O—91——15

OPENING STATEMENT

by

Ralph M. Hall

NASA Authorization Hearing
March 13, 1991

GOOD AFTERNOON. TODAY WE WILL REVIEW THE SPACE-RELATED PROGRAMS OF THE OFFICE OF AERONAUTICS, EXPLORATION, AND TECHNOLOGY.

WHILE THIS OFFICE DOESN'T ACCOUNT FOR A VERY LARGE SHARE OF THE NASA BUDGET, ITS IMPORTANCE SHOULDN'T BE UNDERESTIMATED. IT HAS A HEAVY RESPONSIBILITY, AS IT'S THE KEEPER OF THE AGENCY'S TECHNOLOGICAL "SEED CORN": THE SOURCE OF THE TECHNOLOGY DEVELOPMENTS THAT MAKE FUTURE MISSIONS POSSIBLE, HELP KEEP AMERICA A LEADER IN SPACE, AND PROVIDE BENEFITS BACK HERE ON EARTH.

JUST AS IT IS IMPORTANT FOR INDUSTRY TO SPEND ON R&D IF IT IS TO REMAIN COMPETITIVE OVER THE LONG TERM, NASA NEEDS TO INVEST IN THE FUTURE THROUGH TECHNOLOGY. UNFORTUNATELY, THOUGH, IT'S OFTEN HARD TO ADOPT A LONG-RANGE PERSPECTIVE WHEN WE'RE FACED WITH IMMEDIATE BUDGETARY DIFFICULTIES. WHILE WE DON'T WANT TO WASTE MONEY NEEDLESSLY ON MISGUIDED "HOBBY SHOP" EFFORTS, WE DO THINK A STRONG, BUT DISCIPLINED, NASA R&D EFFORT IS IN THE NATION'S INTEREST.

THE OFFICE OF AERONAUTICS, EXPLORATION, AND TECHNOLOGY ALSO IS--AS ITS NAME SUGGESTS--THE FOCUS OF NASA'S HUMAN EXPLORATION ACTIVITIES. WE WANT TO FIND OUT TODAY HOW NASA PROPOSES TO CONDUCT ITS EXPLORATION PROGRAM IN THE WAKE OF THE AUGUSTINE COMMITTEE'S RECOMMENDATIONS AND

ON THE EVE OF THE SYNTHESIS GROUP'S REPORT. WE HOPE THAT NASA'S PLAN'S WILL PROVE TO BE INNOVATIVE, FLEXIBLE, AND FISCALLY RESPONSIBLE.

NOW I'D LIKE TO TURN TO MR. SENSENBRENNER FOR HIS COMMENTS.

Mr. HALL. At this time, I recognize the gentleman from Texas, Mr. Smith, for an opening statement.

Mr. SMITH. Thank you, Mr. Chairman. Let me compliment you publicly for starting this hearing in such a timely fashion.

Both the Augustine Report and the National Commission on Space suggest that NASA's advanced technology program funding be increased two- to three-fold.

The Augustine Report further recommends that NASA develop an overall technology development plan that includes input from both universities and industry. I strongly believe that universities should have more of a role in the technology development and application process.

Universities and private research facilities have a great deal of intellectual firepower to bring to bear on the task of developing new technologies.

For example, in San Antonio, Texas, researchers at the University of Texas Health Science Center invented and patented a new device to measure bone growth in humans. This device holds great promise in better understanding the medical efforts of long duration, manned space flight on the human body.

This is a prime example of how university-based research directly benefits the space program. I would encourage NASA to further develop and demonstrate this technology.

The Texas Space Grant Consortium is another institution that stands ready to develop space technology for NASA. This consortium with 21 Texas universities represents an excellent pool of laboratories, scientists, and engineers that could undertake space technology projects in a cost-effective manner for NASA.

Yet, NASA must take the first step by contracting more of its technology development programs with universities. I urge NASA to make university-based research a larger part of their technology development efforts. I look forward to working with you, Mr. Chairman, to make sure this takes place.

Thank you, Mr. Chairman.

[The prepared opening statement of Mr. Smith follows:]

OPENING STATEMENT BY REP. LAMAR SMITH
SUBCOMMITTEE ON SPACE
MARCH 13, 1991

Thank you, Mr. Chairman.

Both the Augustine Report and the National Commission on Space suggest that NASA's advanced technology program funding be increased two to three-fold.

The Augustine report further recommends that NASA develop an overall technology development plan that includes input from both the university and industry constituency.

I strongly believe that universities should have more of a role in the technology development and application process.

Universities and private research facilities have a great deal of intellectual firepower to bear on the task of developing new technologies.

For example, in San Antonio, Texas, researchers at the University of Texas Health Science Center invented and patented a new device to measure bone growth in humans.

This device holds great promise in better understanding the medical effects of long duration manned space flight on the human body.

It could give us new data on how broken limbs heal in space as well as how bones lose calcium.

This is a prime example of how university-based research directly benefits the space program, and I encourage NASA to further develop and demonstrate this technology.

The Texas Space Grant Consortium is another institution that stands ready to develop space technology for NASA.

This consortium of 21 Texas universities represents an excellent pool of laboratories, scientists and engineers that could undertake space technology projects in a cost-effective manner for NASA.

Yet NASA must take the first step by contracting more of its technology development programs with universities.

I urge NASA to make university-based research a larger part of their technology development efforts, and I look forward to working with you, Mr. Chairman, to see that this takes place.

Mr. HALL. Thank you for that. Without objection, we want to grant permission for the photographic coverage of the proceedings. I think most of you know we are just in the process of a vote, and that we'll have members attending as they vote and get back by their office to pick up their files. One such very valid and valued member of this subcommittee is Mr. Sensenbrenner, the Ranking Minority Member. We recognize Mr. Sensenbrenner for his comments.

Mr. SENSENBRENNER. Today's hearings will take us into the proverbial unknown. Naturally, I am referring to the Space Exploration Initiative and the other technology development challenges of the office that we are hearing today. One thing is certain, however. The long-term success of the U.S. space program has been vested in this office. The enabling technologies needed to continue our missions both to and from Planet Earth depend upon this office. It is for that reason that I am anxious to learn more about the Space Exploration Initiative from you.

The Space Exploration Initiative, or SEI, is frequently described as the strategic horizon for NASA. This strategic horizon is said to help NASA direct, focus, and integrate its current and future activities, which I wholeheartedly agree need direction, focus, and integration.

The advisory committee on the future of the U.S. space program—the Augustine Committee—noted that while it is possible to conceive of a space program without a long-term vision such as the human exploration of Mars, the "jewel represented by the vision of a seemingly unattainable goal, the technologies engendered, and the motivation provided . . ." were significant enough for the Augustine Committee to recommend the mission from Planet Earth be established, but only on a "go-as-you-pay" basis.

The question invited by the Augustine Committee's view on this subject is this: If the strategic horizon is necessary and helpful to the agency's pursuit of excellence and science, why isn't there a timetable to reach the horizon?

If there were such a timetable, even a very long one, I suspect NASA would be able to retain the brains it needs to fulfill its mission, better able to set priorities in reference to the horizon, and otherwise become more cohesive as an agency.

Finally, if the Chairman will indulge me, it is hard to believe our troops would be coming home from the Persian Gulf today if General Schwarzkopf and General Powell told the President that the liberation of Kuwait could be accomplished without a timetable.

As NASA moves forward to the Space Exploration Initiative, all of its technology research and development programs will find greater application in all NASA missions by having a set of imperatives. Absent a pressing need to liberate the Planet Mars, Congress someday may need to impose an "artificial" timetable for SEI, if only to assure the American taxpayer maximum agency performance.

Thank you, Mr. Chairman. I look forward to hearing from Mr. Aldrich this afternoon.

[The prepared opening statement of Mr. Sensenbrenner follows:]

OPENING STATEMENT
By
HON. F. JAMES SENSENBRENNER

FY92 NASA BUDGET HEARING
Office of Aeronautics, Exploration and Technology
March 13, 1991

Mr. Arnold D. Aldrich
Associate Administrator

and

Dr. Robert Rosen
Deputy Associate Administrator

GOOD AFTERNOON, MR. CHAIRMAN, MR. ALDRICH, AND DR. ROSEN. TODAY'S HEARING WILL TAKE US INTO THE PROVERBIAL UNKNOWN. NATURALLY I AM REFERRING TO THE SPACE EXPLORATION INITIATIVE AND THE OTHER TECHNOLOGY DEVELOPMENT CHALLLENGES OF YOUR OFFICE WE WILL VISIT TODAY.

ONE THING IS CERTAIN, HOWEVER. THE LONG-TERM SUCCESS OF THE U.S. SPACE PROGRAM HAS BEEN VESTED WITH YOUR OFFICE. THE ENABLING TECHNOLOGIES NEEDED TO CONTINUE OUR MISSIONS BOTH TO AND FROM PLANET EARTH DEPEND ON YOU. IT IS FOR THAT REASON I AM ANXIOUS TO LEARN MORE FROM YOU ABOUT THE SPACE EXPLORATION INITIATIVE.

THE SPACE EXPLORATION INITIATIVE, (SEI), IS FREQUENTLY DESCRIBED AS THE STRATEGIC HORIZON FOR THE AGENCY. THIS STRATEGIC HORIZON IS SAID TO HELP NASA DIRECT, FOCUS, AND INTEGRATE ITS CURRENT AND FUTURE ACTIVITIES, WHICH I WHOLE-HEARTEDLY AGREE NEED DIRECTION, FOCUS AND INTEGRATION.

THE ADVISORY COMMITTEE ON THE FUTURE OF THE U.S. SPACE PROGRAM-- THE AUGUSTINE COMMITTEE-- NOTED THAT WHILE IT IS POSSIBLE TO CONCEIVE OF A SPACE PROGRAM WITHOUT A LONG-TERM VISION SUCH AS THE HUMAN EXPLORATION OF MARS, THE "JEWEL REPRESENTED BY THE VISION OF A SEEMINGLY UNATTAINABLE GOAL, THE TECHNOLOGIES ENGENDERED, AND THE MOTIVATION PROVIDED..." WERE SIGNIFICANT ENOUGH FOR THE AUGUSTINE COMMITTEE TO RECOMMMEND THE MISSION FROM PLANET EARTH BE ESTABLISHED, BUT ONLY ON A "GO AS YOU PAY" BASIS.

THE QUESTION INVITED BY THE AUGUSTINE COMMITTEE'S VIEW ON THIS SUBJECT IS THIS: IF THE STRATEGIC HORIZON IS NECESSARY AND HELPFUL TO THE AGENCY'S PURSUIT OF EXCELLENCE AND SCIENCE, WHY ISN'T THERE A TIMETABLE TO REACH THE HORIZON?

IF THERE WERE SUCH TIMETABLE, EVEN A VERY LONG TIMETABLE, I SUSPECT NASA WOULD BE BETTER ABLE TO RETAIN THE BRAINS IT NEEDS TO FULFILL ITS MISSION, BETTER ABLE TO SET PRIORITIES IN REFERENCE TO THE HORIZON, AND OTHERWISE BECOME MORE COHESIVE AS AN AGENCY.

FINALLY, IF THE CHAIRMAN WILL INDULGE THIS COMPARISON, IT IS HARD TO BELIEVE OUR TROOPS WOULD BE COMING HOME FROM THE PERSIAN GULF TODAY IF GENERAL SCHWARZKOPF AND GENERAL POWELL TOLD PRESIDENT BUSH THAT THE LIBERATION OF KUWAIT COULD BE ACCOMPLISHED WITHOUT A TIMETABLE.

AS NASA MOVES FORWARD WITH THE SPACE EXPLORATION INITIATIVE, ALL

ITS TECHNOLOGY RESEARCH AND DEVELOPMENT PROGRAMS WILL FIND GREATER APPLICATION IN ALL NASA MISSIONS BY HAVING A SET OF IMPERATIVES. ABSENT A PRESSING NEED TO LIBERATE THE PLANET MARS, CONGRESS SOMEDAY MAY NEED TO IMPOSE AN "ARTIFICIAL" TIMETABLE FOR SEI, IF ONLY TO ASSURE THE AMERICAN TAXPAYER MAXIMUM AGENCY PERFORMANCE.

THANK YOU MR. CHAIRMAN. I LOOK FORWARD TO HEARING FROM MR. ALDRICH THIS AFTERNOON.

Mr. HALL. Thank you, Mr. Sensenbrenner.

The Chair recognizes the gentleman from California, Mr. Packard.

Mr. PACKARD. I have no statement, Mr. Chairman.

I just want to welcome Mr. Aldrich. I'm looking forward to your testimony.

Mr. HALL. The Chair recognizes Mr. Henry.

Mr. HENRY. I have no opening statement, Mr. Chairman.

Mr. HALL. All right, it looks like they are saving all of their energy for cross-examination, Mr. Aldrich, when you finish.

We are honored to have Mr. Arnold D. Aldrich, Associate Administrator, Office of Aeronautics, Exploration and Technology; accompanied by Dr. Robert Rosen, Deputy Associate Administrator, Office of Aeronautics, Exploration and Technology of NASA. We recognize you at this time to summarize, if you would, your testimony. Without objection, your entire written speech will be put into the record, and then we'll develop it into the question-and-answer series. We recognize you at this time.

STATEMENT OF ARNOLD D. ALDRICH, ASSOCIATE ADMINISTRATOR, OFFICE OF AERONAUTICS, EXPLORATION AND TECHNOLOGY, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, NASA, ACCOMPANIED BY ROBERT ROSEN, DEPUTY ASSOCIATE ADMINISTRATOR

Mr. ALDRICH. Thank you, Mr. Chairman.

I'm delighted to have this opportunity to present to you NASA's fiscal year 1992 budget request for the Space Research and Technology Program and for the Space Exploration Initiative.

I believe that today we are at a critical crossroad in space technology. This committee, along with many advisory groups, has long recognized that investment in technology is an investment in the future. Further, all of these groups have agreed that the Nation's technology storehouse of knowledge, capabilities, and trained people must be replenished and strengthened.

The fiscal year 1992 budget that the President has sent to Congress responds to these concerns. It is a critical step towards revitalizing the health of the Nation's Space Technology Foundation.

The benefits of a strong technology program are clear. Advances in space technology sustain our basic research in key critical disciplines, enhance the safety, reliability, and performance of our space transportation systems, develop capabilities for advanced space science missions, improve our ability in space in effective ways, lay the building blocks needed to expand human presence beyond the solar system, and here on Earth, enhance the technical education and space research capability of our universities.

This budget will provide the necessary resources to conduct a broadly based and balanced space research and technology program. The request represents a substantial increase over our current program and demonstrates our commitment to supporting future space science, space transportation, space station, and space exploration needs.

The growth in the 1992 program will support important needs in all these areas. The program will include an augmented effort to

developed advanced science sensor technologies to enhance the capabilities of the Earth Observing System. It will provide strong support for our Earth to orbit transportation research needs. It will provide the minimum funding necessary to ensure progress with the aero-assist flight experiment, which will test aero-braking techniques to enhance a wide range of future important missions. It will provide an advanced program in space automation and telerobotics to improve our capabilities of operating in space. It will provide the funding required for pursuit of critical long-range technologies vital to our next major challenge, the exploration of the solar system.

The fiscal year 1992 Space Research and Technology Program is an essential investment in enabling America to remain at the forefront in science and engineering. Your support for a revitalized Space Technology Foundation will help us realize an exciting and challenging future in space.

Now, I would like to turn to the Space Exploration Initiative. Our 1992 Space Exploration Initiative budget request reflects those resources necessary to proceed forward toward the goal of developing the knowledge and experience to determine how best to proceed to return to the Moon and to venture on to Mars.

The budget supports continuation of our exploration mission studies, which are used by NASA to perform technical and programmatic analyses of SEI architectures, including those to be recommended soon by General Tom Stafford's Synthesis Group. Mission studies are the central element of SEI planning, enabling us to integrate technology development, life and space science research, robotic mission strategies, space station utilization plans, and national launch system requirements. These studies ultimately will produce exploration program implementation recommendations and associated resource requirement estimates.

The other SEI budget area for which my office is directly responsible is the Exploration Technology Program. These Exploration Technology funds will enable us to work on several of the most highly critical SEI technology areas to enable a broad range of future SEI architecture options. These technologies include nuclear power, nuclear propulsion, space-based engines, and human life support.

I would also like to briefly mention those areas in NASA's SEI budget request which are the responsibility of the Office of Space Science and Applications. Before we can send humans on long-duration exploration missions, we have much work to do to understand and mitigate the risks to human crews.

NASA's 1992 request appropriately includes funding for life science research, space radiation research, and for initiation of a Lifesat Program. Lifesat will feature re-usable satellites, which will enable study of the direct effects of weightlessness on the radiation sensitivity of tissues. It will test a wide variety of radiation shielding materials. We have been working closely with OSSA to define and support these and other SEI life science's research requirements.

In summary, the fiscal year 1992 budget request will enable the Space Exploration Initiative to function as the space program's strategic horizon that it is intended to be, by supporting a variety

of activities critical to defining plans for the robotic and human exploration of the solar system. These activities are a prudent investment that will provide us with a better understanding of the requirements and challenges associated with the exploration of the Moon and Mars. Our goal is to develop specific, well-understood program options over the next several years, for consideration by the Administration and Congress in future decisions on how best to proceed to expand human presence beyond Earth orbit.

That concludes my prepared introduction. I would be pleased to answer whatever questions you would have, Mr. Chairman.

[The prepared statement of Mr. Aldrich follows:]

STATEMENT

OF

Mr. Arnold D. Aldrich
Associate Administrator for
Aeronautics, Exploration and Technology

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

before the

Subcommittee on Space
Committee on Science, Space and Technology
House of Representatives

March 13, 1991

Mr. Chairman and Distinguished Members of the Subcommittee:

I am delighted to have this opportunity to present to you NASA's FY 1992 Space Research and Technology program and the Space Exploration Initiative (SEI). I look forward to working closely with the new Chairman of the Space Subcommittee and its members to assure that the Space Research and Technology program and SEI enable us to achieve our Nation's goals in space. With your support, we will be able to continue to expand the frontiers of knowledge and reap the benefits of space research and exploration for our Nation, now and for the future.

In today's statement I will discuss the Office of Aeronautics, Exploration and Technology (OAET) space technology program, highlight our current technology activities, explain our FY 1992 budget request and describe where our program is headed. I will then discuss the Space Exploration Initiative (SEI) and, in particular, outline the initial steps NASA is taking to assess program options on SEI for the exploration of the Moon and Mars employing both human beings and robotic spacecraft.

SPACE RESEARCH AND TECHNOLOGY

The benefits of a vital technology program have been long recognized by NASA as well as by many advisory groups comprised of both industry and academia, and by this Committee. These groups have agreed upon two central points -- that investment in technology is critical to maintaining U.S. competitiveness and assuring world leadership, and that NASA should increase funding in this vital area.

Over the last several years, concern has been steadily growing regarding our need to replenish the Nation's technology storehouse of knowledge, capabilities, and trained people. The Report of the Advisory Committee on the Future of the U.S. Space Program, chaired by Mr. Norman Augustine, has stated that the "technology base of NASA has now been starved for well over a decade and must be rebuilt if a sound underpinning is to be regained for future space missions."

With this budget request of $421.8 million for the FY 1992 space research and technology program, we are sending the strong message that NASA is responding to these concerns. With this request, we are taking steps toward keeping America at the forefront of research and technology.

This request will support a broad-based space research and technology program that will enable us to achieve our national goals in space. Our technology efforts will assist in enabling the development of new space launch capabilities that will ensure more reliable and affordable access to space. Our technology program will contribute to improving our understanding of the Earth and space sciences. Technology advances will be key to opening the frontiers of space and expanding human presence into the solar system. And, as important, investment in technology is vital to strengthening U.S. industrial and academic engineering and research capabilities.

The benefits of technology investments are clear -- increased mission safety and reliability; lower development and operations costs; reduced development time; and enhanced mission performance. Let me cite two recent examples to illustrate how our technology efforts have contributed to the success of NASA and U.S. industry missions. In support of space science missions during the early 1980's we developed the world's first large-swath, real-time synthetic aperture radar ground processor. This processor forms the heart of the Magellan ground processing system, producing the remarkable images of the planet Venus that we have seen during this past year.

In the area of propulsion technologies, we have developed an arcjet thruster system for satellite stationkeeping that offers an increase in performance of approximately one and a half to two times the performance currently available from state-of-the-art spacecraft propulsion systems. This technology is of particular interest to the commercial communication satellite industry since this increase in performance can be used to extend satellite life or to reduce launch costs by permitting the use of smaller

launch vehicles. Competitive advantages, such as these, resulted in a recent decision by AT&T to baseline arcjets for use on the Telstar-4 satellite series.

SPACE RESEARCH AND TECHNOLOGY STRATEGY

The strategy of our Space Research and Technology efforts is to provide a balanced, multidisciplinary program to meet the Nation's needs for future civil space missions. This program addresses requirements developed through an intensive and continuous dialogue with technology users from NASA, U.S. industry, and the academic community. The Space Technology program represents a balanced investment for near-term and longer-term needs in support of the following five areas:

- Space Science - development of advanced observation, information, spacecraft and operations technologies to maximize the return from the full spectrum of space and earth science missions

- Transportation - enhancement of the safety, reliability and performance of earth-to-orbit and space transportation systems

- Space Station - improvement of our ability to operate in space effectively by increasing Station productivity, safety and maintainability and to utilize Space Station Freedom for technology demonstration research

- Exploration - provision of key technologies for robotic and human solar system exploration missions required for the Space Exploration Initiative

- Breakthrough - advancement of high payoff, highly innovative technology concepts with the potential for revolutionary improvements in space capability; these activities are characterized as "technology-push" -- not tied to specific user requirements but offering potential for quantum jumps in performance

SPACE RESEARCH AND TECHNOLOGY PROGRAM

This budget request of $421.8 million provides the necessary resources to conduct a balanced technology program critical to realizing the Nation's future civil space goals. The request represents a substantial increase over our current program and demonstrates our commitment to supporting future space science, space transportation, space station and space exploration needs. The growth in the FY 1992 program will support an augmented effort to develop science sensor technologies to enhance the capabilities of the Earth Observing System (EOS); an enhanced program in space automation and telerobotics to improve our understanding of how to operate in space; and a minimum level required for pursuit of critical long-range technologies vital to our next challenge -- exploration of the solar system.

The Space Research and Technology program consists of five elements. The first, the Research and Technology (R&T) Base, supports basic research activities in key technology disciplines. The second, the Civil Space Technology Initiative, addresses technology efforts to enhance current systems and to enable near-term mission capabilities. The third, the Exploration Technology program, will lay the key technology foundation necessary for future solar system exploration missions. The fourth element, the In-Space Technology Experiments Program, extends ground-based research efforts by supporting the development of space technology experiments on behalf of university, industry, and NASA technologists. And, with this budget request, we are initiating a new focused effort this year, the Space Automation and Telerobotics program, to address artificial intelligence and telerobotics technologies which increase operational capability, safety and productivity for future NASA missions and operations.

Let me now highlight some of our technology accomplishments over the past year and point out what we intend to accomplish with our FY 1992 budget.

Research and Technology Base

The FY 1992 request for the R&T Base is $141.6 million. This will support basic disciplinary research in aerothermodynamics, materials and structures, power and propulsion, information and controls, human support, and other key space technology fields. Included in this request are funds for the OAET university space research program, one element of which is the University Space Engineering Research Center program (USERC). The goal of USERC is to broaden and strengthen the capabilities of the Nation's academic engineering community.

In FY 1991, two particular accomplishments should be highlighted: first, the important results from our analyses of the unique data we obtained from the Long Duration Exposure Facility (LDEF) and, secondly, the university space research activities. The LDEF spacecraft was retrieved in January 1990 after five and a half years in space. The invaluable information from LDEF regarding the long-term effect of exposure to the space environment has already directly influenced Space Station design and other space system environmental requirements. For example, the radiation shielding data from LDEF has contributed to the understanding of radiation issues and has improved the models used to develop Space Station radiation protection requirements. Solar cell data has shown that the solar array and radiator coatings for the Space Station photovoltaic array designs are durable. The meteoroid and debris impact data will improve our models in the smaller size range which has not been measurable from ground-based systems or short-term sampling on Shuttle missions. Chemical analysis of LDEF impact craters will yield important information on the origin and composition of meteoroids and space debris.

The USERC program, begun in 1988, has resulted in exciting educational and technical accomplishments this year. The program has already contributed to expanding the Nation's engineering talent base by supporting the development of space-related academic courses. Each of the nine USERC Centers has developed at least two new engineering courses thus far. Several of the USERC Centers, in partnership with industry, have begun to produce strong technical results as well. For example, the Center at the University of Idaho has designed and developed a very large-scale integrated chip which is being incorporated into the Hubble Space Telescope ground data capture system. This is the first use in a NASA mission of a product from the USERC program.

Another example of progress is the effort between North Carolina State/North Carolina Agricultural and Technical Universities (N.C.A&T) and the McDonnell Douglas Space Systems Company. With support from McDonnell Douglas, researchers and students at the university Center designed and fabricated a mockup of an aerobrake suitable for Mars missions. Using both a suited astronaut and a robotic arm, assembly of the mockup under simulated weightless conditions was tested in the McDonnell Douglas neutral buoyancy tanks in California. Six teams of students in mechanical and aerospace engineering from the two schools (52 students in all) worked on the design of the aerobrake. The Chancellor of N.C. A&T reported that the visibility and level of excitement generated by this program was an invaluable contribution to strengthening engineering education at his university.

Beside the basic disciplinary advances discussed above, the R&T Base continues to produce technology products which have been applied to flight systems by industry and other users. Examples include the arcjet, mentioned earlier in my testimony, and advanced lithium batteries which will be used by the Air Force on the Centaur vehicle.

In FY 1992, the R&T Base will continue to support key core capabilities in critical technology disciplines as well as sustaining our support for the university research program. Additional emphasis will be placed on high-leverage technologies in support of future transportation systems and space science missions. This will include research in aerothermodynamics, and materials and structures.

Civil Space Transportation Initiative (CSTI)

The CSTI program was initiated in 1988 to advance certain specific high-leverage technology improvements beyond basic research in order to expand and enhance system and vehicle capabilities for near-term missions. CSTI takes critical technologies to the point that the user can confidently incorporate these new or expanded capabilities into relatively near-term, high priority NASA mission applications. In particular, CSTI focuses on reliable and cost-effective access to, operations in, and science missions from Earth orbit.

In FY 1991, the CSTI program continued to produce significant accomplishments in key technologies. For example, in support of the agency's requirements in space science, the precision segmented reflector program successfully completed its planned research activities. During the four-year course of this effort, advanced composite reflector panels were developed, providing better than a threefold reduction in weight over state-of-the-art glass panels; multi-panel control methodology was demonstrated; and a lightweight, erectable support truss concept was designed, fabricated and tested demonstrating unprecedented surface accuracy for a four-meter class structure. This technology will have significant benefit for future large orbiting astrophysical telescopes operating in the submillimeter spectrum by enabling a reduction in instrument weight.

In support of future transportation systems, the earth-to-orbit research effort has test-fired a 40,000-pound-thrust combustion chamber. The chamber was produced using a unique vacuum plasma spray fabrication process. This advanced combustion chamber, using a one-piece cast jacket and integral manifolds, will eliminate uninspectable critical welds. This technology effort will contribute to the fabrication of highly reliable main combustion chambers while decreasing manufacturing time to a third of that currently required. In support of future transportation missions, the Aeroassist Flight Experiment completed the critical design reviews for the aerobrake, the carrier vehicle and eight of the experiments. In addition, fabrication of the aerobrake structural test article has been initiated.

Because the CSTI program appropriation for FY 1991 was reduced by $52.0 million from our requested level, many planned research activities were terminated or delayed. Almost all ongoing activities within the CSTI program were seriously affected by the FY 1991 budget reduction, including planned technology delivery dates in support of future transportation missions and operational activities in earth orbit. One of the most seriously affected activities was the Aeroassist Flight Experiment and we anticipate that the projected flight date will slip significantly.

Our FY 1992 request of $114.3 million for the CSTI program will allow OAET to maintain and meet planned technology delivery dates so user organizations can proceed as planned with their related missions. We intend to sustain our support for space science missions through technology efforts in advanced sensors and improved data systems capabilities. We are also including with this budget request an augmented effort to develop advanced mechanical coolers and infrared detectors with performance and lifetime characteristics that will enhance the scientific return from future Earth observing missions. This area, which will support a broad range of future remote sensing instruments, has been identified by the Office of Space Science and Applications as their highest priority technology need.

For solar system exploration missions, FY 1992 CSTI activities in high capacity power and aerobraking are focused on critical enabling technologies. The Aeroassist Flight Experiment will contribute to aerobrake designs which can significantly reduce the mass of propellant needed to be launched into orbit for planetary missions through the development of aerobraking techniques. The high capacity power program is developing power conversion, thermal management and materials technologies to enable major increases in the life and power output of space nuclear power systems which are essential for large lunar base activities and for major missions to the planets, both robotic and manned.

Space Automation and Telerobotics

In FY 1992, NASA is requesting $82.9 million to initiate a new budget line, Space Automation and Telerobotics, to provide artificial intelligence and telerobotics technologies to increase operational capability, safety and productivity of future space missions. This effort will combine the technology elements of the Flight Telerobotic Servicer (FTS) program, (previously part of the Space Station program), with the artificial intelligence and telerobotics activities previously conducted as part of CSTI. The transfer of the FTS technology elements to OAET is an excellent opportunity for NASA to couple the existing telerobotics technology efforts with those associated with the FTS. This will result in a revitalized research effort in a technology area critical to a broad spectrum of future civil space missions.

This program will also provide critically needed technology advances for science data analysis techniques, spacecraft operations and mission control. The program will focus on several application areas: ground-based launch processing, local proximity space operations, remote manipulation with significant time delay and remote systems requiring high degrees of autonomy. The effort now includes a range of activities from component-level technology to flight experiment demonstrations.

A recent example of a successful applications demonstration in the artificial intelligence area was the use in mission control of a real time display from the orbiter reaction control thruster system during Space Shuttle Flight STS-31 in April 1990. The expert system monitored the thirty-eight primary reaction control system jets. On flight day, three jets were lost due to a manifold leak. The system displayed the loss of these thrusters and determined that there was no loss of control capability. It also provided simulation to analyze further thruster loss and concluded that the loss of specific thrusters would result in loss of forward motion control. The successful demonstration of this expert system illustrates the benefits from artificial intelligence technology -- real time fault detection, isolation and recovery advice. Our future plans in this area include upgrading flight controller consoles to include additional real time data system capabilities and adding the ability for coordination between expert systems.

Exploration Technology Program

NASA is requesting $52.0 million in FY 1992 for the Exploration Technology Program to build the foundation essential to meeting the challenge of solar system exploration. The approach that OAET is pursuing for the FY 1992 Exploration Technology program is to address key technology challenges that require the longest development time. We intend to make the best possible start on these highest priority technology projects.

Although significantly reduced from our request, the FY 1991 Exploration Technology Program has nevertheless continued to produce accomplishments in key focused technologies for transportation and operations in space. In FY 1991, due to funding reductions, we restructured the space nuclear power program, SP-100, in concert with our government partners, the Departments of Energy and Defense, and a strong new program approach has been established. Highlights of our technology accomplishments in the SP-100 program are in three critical areas: thermoelectric cell development, nuclear fuel development, and reactor vessel fabrication processes and materials development. Thermoelectric material test data have repeatedly confirmed 20-30% performance improvements, and key cell components such as the high voltage electrical insulator and the thermally conductive compliant pads have been successfully fabricated and tested at design operating temperatures. Development and production of the nuclear fuel pellets for the ground test reactor have been completed. And, finally, the processes for fabricating critical high temperature reactor vessel components have been successfully demonstrated.

We have also had exciting developments in the planetary rover project at Carnegie Mellon University where a six-legged rover testbed, building on a successful first test walk, traversed autonomously over rugged terrain in November 1990. A wheeled vehicle, under development at the Jet Propulsion Laboratory, successfully completed its first semi-autonomous navigation test in May 1990 and traversed 100 meters autonomously in September 1990.

The focus of the FY 1992 Exploration Technology Program efforts will be on ensuring that tangible progress in a select number of technology activities is achieved. We have emphasized those critical technology elements that are broadly applicable to most or all potential architectures and which will require a number of years of significant effort to mature. These technology activities will support space exploration mission requirements in space transportation, human support, surface operations, and nuclear propulsion.

More specifically, for future space transportation requirements, we will be pursuing technology activities needed to develop high-performance, cryogenic expander-cycle space-based engines. For surface operations needs, we will continue to develop and validate the space nuclear power technologies required for safe

and reliable nuclear power systems to support lunar outpost and Mars exploration missions. We will focus our human support activities on regenerative life support, radiation protection, extravehicular activity systems, and exploration human factors. And we will be pursuing nuclear propulsion technologies which offer significant advantages in reduced weight, transit times and operational flexibility over chemical based systems for missions to Mars.

In-Space Technology Experiments

NASA requests $16.0 million in FY 1992 for the In-Space Technology Experiments Program (INSTEP). This program develops flight experiments to test highly innovative technology concepts that require research, testing and validation in the space environment. Taking these experiments into space allows us to understand basic phenomena, reduce risk to potential users, and increase the rate of technology transfer to future space missions. This program is designed to provide near-term opportunities for the private sector and university space engineering communities, as well as NASA, to conduct in-space experiments.

In July 1991, we will fly the first experiment developed through INSTEP, the Tank Pressure Control Experiment. This experiment will be followed by the Middeck Zero Gravity Dynamics Experiment and the Heat Pipe Performance Experiment in the first quarter of 1992. In addition, the FY 1992 funds will be used to continue development of twenty-five follow-on experiments already approved within this program.

To continue meeting the advanced technology needs of the space program, NASA will release a new INSTEP Announcement of Opportunity for feasibility studies beginning in FY 1992. Over a thousand companies and universities from forty-one states have expressed interest in proposing experiments in response to this new Announcement of Opportunity.

National Capability

Our ability to accomplish goals in space depends on more than developing and testing technologies. Key additional components are the development of qualified engineers and researchers -- within NASA and in industry and universities -- as well as providing for the necessary facilities and support to accomplish their objectives.

In the process of implementing our space research and technology program, we have established several activities specifically designed to encourage university engineering research. These include the University Space Engineering Research Center program, which supports nine interdisciplinary engineering centers engaged in innovative research and technology; the Investigators Research Program, which provides grants to individuals with outstanding credentials and promise; and the University Advanced Space Design program, which funds advanced systems study courses at the senior and graduate level.

NASA Capability

As OAET Associate Administrator, I am responsible for three of the NASA field centers, the Ames Research Center at Moffett Field, California, which includes the Dryden Flight Research Facility at Edwards Air Force Base, California; the Langley Research Center in Hampton, Virginia; and the Lewis Research Center in Cleveland, Ohio. NASA's successful space technology program has demonstrated that program strength builds upon, and requires, outstanding people and facilities. Continued health and strength of NASA's institution, particularly its people and its unique research facilities, are of critical importance. We need to match development of our new programs with a corresponding long-term investment in human resources and state-of-the-art facilities which will support advances in critical space technologies.

I strongly urge your support of the revitalization and invigoration of NASA's workforce and facilities as represented in the budget requests for Research and Program Management (R&PM) and Construction of Facilities (CofF). Such support is central to the continued success of the Nation's civil Space R&T program.

Space Technology: A Critical Crossroad

The FY 1992 budget request for the Space Research and Technology program represents a unique opportunity for revitalization of the Nation's space technology foundation. This budget request is a critical step in response to the concerns expressed by a broad spectrum of industry, academic, and Administration leaders regarding the necessity to reinvigorate our technology storehouse.

The Space Research and Technology program proposed herein will ensure that we effectively support our near-term goals for space science, transportation, and Space Station missions. It will sustain our basic research efforts in key technical disciplines. It will lay the building blocks to allow us to achieve our future vision of space - human and robotic exploration of the solar system. And, finally, this program will be an essential investment in enabling America to remain at the forefront in science and engineering by encouraging students and supporting educational programs, by supporting necessary facilities, and by establishing compelling goals and opportunities to attract the next generation of technological leaders. Your support for a vital civil space technology foundation will help us realize an exciting and challenging future in space and expand the frontiers of the future for the benefit of all Americans.

THE SPACE EXPLORATION INITIATIVE

The Space Exploration Initiative (SEI) establishes the long-term goal for the civil space program as it reaches out beyond low Earth orbit. The goal is to return to the Moon, this time to

stay, and to carry out the human exploration of Mars. In stating this goal, SEI makes explicit what has long been implicit. It builds upon mankind's heritage of exploring the planet Earth and upon 30 years of exploring the solar system with both unmanned and manned spacecraft.

SEI is not "the next manned space flight hardware program." Rather, it is the strategic horizon needed to focus and integrate many current and future space program activities. As such, it establishes a framework for coherent investment and effective use of available resources. It also provides a yardstick against which progress can be measured. For years critics of the space program have complained that NASA lacked a long-range vision. Now we have that vision. And with it, NASA has a responsibility to plan, and prepare for its implementation.

SEI activities over the next few years will not develop massive hardware systems, but rather will develop the knowledge, experience, and cost estimate base that will ultimately be used to decide how best to proceed. These activities, many of which exist in some form today, are preparatory in nature and include life science research, technology development, solar system data gathering, science opportunity definition, and the mission studies which shape and integrate all other activities. Preparatory activities, in and of themselves, will produce significant benefits for a modest investment.

Our strategy is to accomplish the necessary preparatory work so that well-understood exploration options can be presented to our Nation's political leadership for consideration.

SEI and National Policy

Our expectation that sometime early in the next century men and women will return to the Moon and, later, embark upon the exploration of Mars is not simply the vision of dreamers and professional planners. The exploration of space is an explicit objective of the national space policy to "expand human presence and activity beyond Earth orbit into the solar system."

The policy was approved by President Bush on November 2, 1989. Several months earlier, on the twentieth anniversary of the first lunar landing, the President spoke specifically about returning to the Moon and going on to Mars. Since that time the President has spoken on a number of other occasions on the Space Exploration Initiative, and repeated his conviction that our goal is indeed to return to the Moon and then proceed on to the Red Planet.

The goal of exploring Mars was endorsed recently by the Advisory Committee on the Future of the U.S. Space Program, chaired by Mr. Norman Augustine. The Committee stated:

> "...we share the view of the President that the long term magnet for the manned space program is the planet Mars -- the human exploration of Mars, to be specific. It needs to be stated straight forwardly that such an undertaking probably must be justified largely on the basis of intangibles -- the desire to explore, to learn about one's surroundings, to challenge the unknown and to find out what is to be found. Surely such an endeavor must be preceded by further unmanned visits, and by taking certain important steps along the way, including returning for extended periods to the Moon in order to refine our hardware and procedures and to develop the skills and technologies required for long term planetary living."

To those of us at NASA, and perhaps among the membership of this committee as well, the Space Exploration Initiative reflects what we have long known and intuitively have been working on as the space programs of the 1960s, 1970s and 1980s were carried out. This is that men and women, and robotic systems, are destined to explore our solar system. Earth orbit is not only a vantage point upon which to look down upon the Earth or to observe distant galaxies. It is also a point of departure for humans to return to the Moon and to journey on to Mars.

Opportunities Presented by SEI

The Space Exploration Initiative will both demonstrate and help enable U.S. leadership in the world community of the 21st century --leadership in vision, in discovery and knowledge, in science and technology.

Opportunities for scientific discovery abound in the Space Exploration Initiative. We will learn more about our solar system and our own planet, and perhaps unravel some of the mysteries of life itself. The discoveries we make will enrich our existence. OAET is working closely with the Office of Space Science and Applications to identify scientific opportunities and develop plans to take advantage of them.

While encouraging and enabling scientific progress, SEI also provides considerable potential for achieving an array of practical benefits on Earth. We are developing a better understanding of some of these benefits, and are working to include in our exploration plans activities that enhance and hasten their impact.

One area in which we are likely to see early benefits is education. NASA foresees that the excitement and challenge of exploring the Moon and Mars will capture students' interest in science, math, and technology. To help make that happen, NASA is working with educators to find ways to incorporate the adventure and discovery of SEI into educational materials in order to cause science to become more real and captivating. OAET is working with NASA's Educational Affairs Division to plan an SEI education strategy conference this summer. Using exploration of the Moon and Mars to enhance already existing educational materials and as

a basis for new ones, we will help channel students' natural curiosity into higher academic achievement at all grade levels and, perhaps, eventually into choices for careers in science, engineering, medicine, technology, and related fields. In this and other ways, the Space Exploration Initiative can augment the direct investments we make in education to help meet national education goals and create the kind of workforce our country needs to prosper in the 21st century.

SEI, like previous space endeavors, will have many technological and economic benefits. The long-term evolutionary approach we are pursuing can make SEI an important part of a national strategy to maintain our research and technology base, improve our high-technology performance, and strengthen our industries -- enabling the United States to be more competitive in global markets. Because it will require a wide range of advanced technologies in areas such as robotics, life support, propulsion, communications, and power, the Initiative is a prudent investment that will have widespread impacts. In the past, space investments have paid off handsomely, and often in unexpected ways through "spinoff" applications of NASA technology. With SEI, we are taking a careful look at innovative approaches to effectively transferring the technologies developed for the Initiative to assist U.S. industry. By emphasizing technology transfer as we begin developing SEI technologies, we can create near-term economic benefits and create the foundation for long-term economic strength.

One specific area in which technology developed for SEI can be applied here on Earth is in dealing with the environment. Technologies required to sustain human life in space, from pollution reduction and environmental monitoring to waste recycling and efficient energy production, can augment our Nation's direct investments in environmental protection and help us better manage our limited natural resources. Another specific area that will provide benefits is health care, through the biomedical research conducted and the new medical technologies and procedures developed for SEI.

FY 1991 Accomplishments

Last year, I discussed with you an outreach and synthesis program that NASA was planning in response to a request from the Vice President to broadly pursue new and innovative ideas to accomplish SEI. NASA formally began the outreach program last June, to search nation-wide for concepts and technologies that could help us accomplish the goals of SEI better, safer, faster, and cheaper. Ideas were solicited from universities, U.S. industry, professional societies, other federal agencies, and the general public. We received over 2,200 submissions. Each was evaluated by one of two organizations; the American Institute of Aeronautics and Astronautics or the RAND Corporation. These two organizations forwarded their assessments to an independent review group, chaired by General Thomas P. Stafford. This Synthesis Group's task has been to assess and distill the results

of the outreach program and to provide to the NASA Administrator several SEI architecture options, recommended technology priorities, and an assessment of candidate near-term accomplishments. We expect to receive their results within the next few weeks.

While conducting outreach, NASA has continued its in-house technical and programmatic analyses, focusing on areas applicable to a wide variety of architectures. For example, we have evolved a fundamentally new understanding of how a roundtrip mission to Mars could be designed and how it might be affected by alternative propulsion technologies. We also have continued the integrated SEI planning that ties together the many elements associated with a return to the Moon and a journey to Mars. This not only has provided us with a more mature understanding of the interrelationships of various SEI-related elements, but also has aided in the development of the FY 1992 SEI budget request. The plan guides work on preparatory research, technology, and study activities, and provides a foundation for subsequent incorporation of the recommendations of the Synthesis Group. In focusing efforts on life science research and technology development and in providing requirements for Space Station Freedom and the New Launch System, SEI has already added significant value to guiding future NASA activities.

In addition, OAET is establishing a foundation for cooperation with other federal agencies on SEI. NASA has signed a Memorandum of Understanding with the Department of Energy which establishes a basis of cooperation and coordination. Similar agreements with the Department of Defense and the National Science Foundation (NSF) are being finalized. A more specific Memorandum of Agreement has been signed by my office and the Office of Space Science and Applications (OSSA) with the NSF for cooperation on joint Antarctic activities. This agreement will enable NASA to conduct planetary-related research and to test technologies and procedures applicable to operations on lunar and Martian surfaces in the remote antarctic environment. Similarly, experience with advanced power and life support systems and other technologies will benefit NSF's operations in Antarctica.

FY 1992 Budget Request

Our FY 1992 Space Exploration Initiative budget request represents the minimum resources necessary to make modest progress toward the goal of developing, during the next several years, the knowledge, experience, and cost estimate base to decide how best to proceed to return to the Moon and to venture on to Mars. We are requesting $15 million for Exploration Mission Studies, which will be used by NASA to perform technical and programmatic studies on SEI architectures, including those recommended by the Synthesis Group. This level of spending slightly augments FY 1991 support to our in-place core team. Mission studies are the central element of SEI planning, allowing us to integrate technology development, life science research, robotic missions, and Space Station utilization and Nati al

Launch System requirements. These studies ultimately will produce exploration strategy recommendations and associated costs for consideration by the President and Congress. The other SEI budget item for which OAET is directly responsible is $52 million for Exploration Technology which I discussed earlier in this testimony. These funds will allow us to work on several of the most highly critical SEI technology areas that will enable a range of future SEI implementation options.

Let me also briefly mention those areas of NASA's SEI budget request which are the responsibility of the Office of Space Science and Applications. Before we can send humans on long duration exploration missions, we have much work to do to understand and mitigate the risks to human crews. NASA's FY 1992 request appropriately includes $10 million for life science research, $2 million for radiation research and $15 million for Lifesat. The Lifesat program will feature reusable satellites which will enable study of the direct effects of weightlessness on the radiation sensitivity of tissues and will test a variety of radiation shielding materials. We have been working closely with OSSA to define and support these and other SEI life sciences research requirements.

Conclusion

In summary, the FY 1992 budget request will enable the Space Exploration Initiative to function as the space program strategic horizon it is intended to be by supporting a variety of activities critical to plans for defining the robotic and human exploration of our solar system. These activities are prudent investments that will provide us with a better understanding of the requirements and challenges associated with exploration of the Moon and Mars.

Our goal is to prepare specific, well understood program options for consideration by the President and Congress for future decisions regarding how to proceed to expand human presence beyond Earth orbit.

That concludes my prepared testimony. I would be pleased to answer any questions you might have.

Office of Aeronautics, Exploration and Technology

OAET

(R&D $,M)

	FY 1990	FY 1991	FY 1992
AERONAUTICS R&T	**442.6**	**512.0**	**591.2**
R&T BASE	321.8	336.4	375.6
SYSTEMS TECHNOLOGY	120.8	175.6	215.6
TRANSATMOSPHERIC R&T	**59.0**	**95.0**	**72.0**
SPACE R&T	**284.1**	**290.4**	**421.8**
R&T BASE	125.0	125.7	141.6
IN-SPACE TECH. EXPERIMENTS	10.2	11.2	16.0
CSTI PROGRAM	121.4	119.0	114.3
PATHFINDER PROGRAM	27.5	-	-
EXPLORATION TECH. PROGRAM	-	27.5	52.0
EXPLORATION MISS. STUDIES	(15.0)	7.0	15.0
SPACE AUTOMATION & TELEROBOTICS	-	-	82.9
TOTAL	**785.7**	**897.4**	**1085.0**

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Mr. HALL. Thank you very much. Mr. Rohrabacher of California is with the committee at this time. We recognize him for an opening statement, if he'd care to.

Mr. ROHRABACHER. Thank you very much, Mr. Chairman.

I just would like to note the good work that we're seeing from your office and I'd like to thank you very much. I especially have two individuals that I would like to commend from your office. They are Dick—and I'm going to have to ask for your help in pronunciation of this—it's B-Y-K-U-L-K-U-L, Bykulkul—there it is, and Bruce Webbon, who were two fellows in your operations at the time of the AX-5 spacesuit. They are over at Ames. I just would like to say that they have done a tremendous amount of work. They have been under a lot of pressure because people have sort of discounted their work. There is some competition going on there in terms of the spacesuit, which I am participating in. I think your office does a great job and I am here to listen to you. Thank you very much for the good work you are doing.

Mr. ALDRICH. Thank you. I'm sure those gentlemen appreciate well your comments.

STAFFORD REPORT

Mr. HALL. Thank you, Mr. Aldrich. As you know, the President announced going back to the Moon and Mars. NASA has a rather expensive system set up. I'm told that some others said that wait a minute, maybe there is a better and little cheaper way to do it other than the $450 billion over 29 years. So, I understand General Stafford is heading a report that we do not yet have and will not have until the middle, maybe, of next month sometime. Will that report allude to the coordination that you referred to with other agencies? Do you know, or do you have any input on that?

Mr. ALDRICH. I don't have an input on exactly how it will allude to other agencies, but I'm sure it will recommend approaches and technologies that utilize the full capability of our Federal agency structure. We're already working with both DOD, DOE, and the National Science Foundation. I think they would be partners in what will be recommended by General Stafford.

Mr. HALL. I think the National Space Council pretty much directed that coordination and set up a budget line of $86 million for fiscal year 1992 for SEI, or thereabouts.

Mr. ALDRICH. Yes, Mr. Chairman, the line I was going to discuss is $94 million, but I think we're talking about the same items here.

Mr. HALL. A couple of million here—we'll split the difference and call it $93 million—do you want to? [Laughter.]

NASA'S WORK WITH OTHER AGENCIES ON SEI

Mr. HALL. Really, what is NASA doing to coordinate its SEI work with the other agencies, a little, some, a lot? Why don't you discuss that for us.

Mr. ALDRICH. I believe we've been quite active in seeking out capabilities that relate to SEI, as our NASA studies have characterized it, from the other agencies, particularly the ones I've mentioned. We started working with them well over a year ago to iden-

tify how they could participate in both their levels of interest and their available capabilities and facilities to contribute to SEI.

Two of the most important areas that we see in our long-range technology needs for SEI are nuclear propulsion and nuclear power. We particularly worked with the DOE on expanding programs in that area. We've had an ongoing program in nuclear power for some years that both DOE and DOD participate in. We see continued activity and growth there as it focuses now on the SEI goals.

Mr. HALL. Has partition of the responsibilities taken place yet?

Mr. ALDRICH. We have been working on Memorandums of Understanding (MOU). In the nuclear power area, we've already had a Memorandum of Understanding for several years on the program called the SP-100 program. However, for SEI overall, to reach out beyond that specific activity, we now have a top level MOU between Admiral Truly and Admiral Watkins for SEI, and we're working a similar one with the DOD and also with the National Science Foundation.

Mr. HALL. Is DOD cooperating with you?

Mr. ALDRICH. Very much.

Mr. HALL. They're not dragging their feet?

Mr. ALDRICH. No, sir.

Mr. HALL. Why don't you tell us briefly, and this is my last question, what pitfalls and what impediments you see to the coordination and cooperation that's really needed and was, I think, expected when the National Space Council issued its direction.

Mr. ALDRICH. Well, the Space Council just about little over a year ago really asked us to, from the NASA sole point of view, slow down a little bit. It was really a request to seek out more broadly nationwide to our university community and industry, and to the public at large, for all ideas on all proposals that might relate to SEI, which we endorsed highly and have moved out to do. That was a program called Outreach, which folded into Synthesis. Now Tom Stafford's independent team is reviewing, assessing, and trying to boil down all of the ideas that come in so that recommendations for moving forward with SEI, both in terms of architecture and technical plans, can proceed.

We've continued our work on our technologies and our architectures, but really we've been sort of waiting for the output from the Synthesis Group to again focus architectural proposals and direction in technologies as we move forward into the next several years, to more specifically focus these plans and derive hard recommendations for the program to proceed.

Mr. HALL. Thank you. I think my time's past expired. Before I recognize Mr. Smith from Texas, let me recognize Mr. Cramer of Alabama for any opening statement he may have, if any.

Mr. CRAMER. Mr. Chairman, I have no opening statement.

Mr. HALL. Mr. Bacchus of Florida.

Mr. BACCHUS. Mr. Chairman, thank you, but I have no opening statement.

Mr. HALL. The Chair recognizes the gentleman from Texas, Mr. Smith.

Funding to Universities

Mr. Smith. Thank you, Mr. Chairman. Mr. Aldrich, in my opening statement, I mentioned my interest in seeing NASA contract more frequently with universities. So, my first question is, what is the current level of NASA technology and development funding that is spent in the university community today, either the level or percent?

Mr. Aldrich. I'd like to withhold an answer on NASA overall and report on my budget here. Perhaps for the record, I could report the total NASA number. Within my budget, 15 percent of our budget ends up at universities either through direct grants or through technology that is being implemented in programs with our centers.

Adequacy of SEI Funding

Mr. Smith. That's roughly what I was looking for. NASA's Synthesis Group is expected to come out with a report talking about our options of going back to the Moon or the Mars mission. My question for you there is, is the exploration budget large enough to accommodate a return to the Moon or a new mission to Mars?

Mr. Aldrich. Our budget for fiscal year 1992 is a modest budget in terms of the long range of that program, but it addresses the most important areas we need to proceed as we study further the recommendations that will come from Synthesis. Synthesis has been asked to give us recommendations on several different architectures for conducting the Moon and Mars exploratory programs, and to prioritize key technologies to go with those architectures.

Our request asks for money to continue our mission studies which will take the work from Synthesis and, in detail, analyze, strategize, and put together the full content of what those architectures could and should be in terms of leading us to the planning we can make firm decisions on.

We also have a budget request for the technology to start the most critical early technologies to support SEI. These are technologies we believe would be most important, irrespective of the final architectures that are selected. We believe nuclear power, nuclear propulsion, life support, and space-based engines are technologies we need to start in 1992, even before we know the full pace, schedule, and specific approaches that will go in the years ahead.

Mr. Smith. And then hope the funding will follow, is what you're saying?

Mr. Aldrich. The funding would follow and, as it was earlier mentioned, a schedule for SEI. Part of the Synthesis activity in recommendations is to do the preparatory work that we'll derive over the next several years. The real recommendations for the program, but also for the schedule and schedule points, and for the budgets that we see in the longer term that such programs would take.

Mr. Smith. I have a couple more brief questions. Can you state briefly what the extent of the coordination is with the Department of Energy and Department of Defense in regard to the Moon and Mars missions?

Mr. Aldrich. With the Department of Energy, we have an ongoing prog.am on nuclear power, which we hope to expand in the

years as we go forward toward specific SEI schedule targets. We also hope to initiate this year a program with the Department of Energy on nuclear propulsion, which we see as a very critically enabling technology for the Mars phase on these missions.

With the Department of Defense, we also are exploring nuclear propulsion technologies. Although it is not the responsibility of my office, the new National Launch System, which eventually, we hope, will evolve into a heavy-lift launch system, is one of the key elements required for the later Space Exploration Initiative missions. That work is very active now between the Office of Space Flight and the United States Air Force.

BIOSPHERE II

Mr. SMITH. Thank you for that detailed answer. Lastly, you've heard of the Biosphere II project in Arizona. It's the closed environment where six individuals, I think, are living for two or three years. Do you expect Biosphere II to provide any help to NASA as far as the Space Exploration Initiative goes?

Mr. ALDRICH. We're quite interested in Biosphere II. I visited Biosphere II also about a year ago. We have regular coordination with our NASA life-support teams. How they progress and what they will be able to derive from their experiments, we will certainly couple with our experimentation and ongoing activities. Whatever is beneficial will be integrated with our work.

Mr. SMITH. NASA is not duplicating what is going on in Biosphere II right now, are they?

Mr. ALDRICH. NASA uses quite different approaches to those technologies. Biosphere II is a very unique and different kind of an approach than what NASA would normally conceive.

Mr. SMITH. Mr. Aldrich, thank you for your answers. Thank you, Mr. Chairman.

SEI FUNDING

Mr. HALL. The Chair recognizes Mr. Sensenbrenner.

Mr. SENSENBRENNER. Thank you very much, Mr. Chairman.

I'd like to follow up on the questions of the gentleman from Texas, Mr. Smith, relative to the funding of the lunar Mars exercise. In my opening remarks, I expressed concern that there wasn't a timetable. If there is no goal to reach an end product, it's hard to produce the end product.

The Augustine Commission, of course, recommended an open-ended program. I'd like to know, first, if you agree with that recommendation and, secondly, if there is a certain minimum level of funding that is required in order to accomplish anything on the lunar Mars mission. If we go below that minimum level of funding, we might as well not spend the money at all. If there is that type of a minimum level of funding, could you let us know of that?

Mr. ALDRICH. I'd like to answer both of those, with the second one first. We think this budget for 1992 is the minimum level of funding to make tangible progress during this year. However, in the technology area, since technology is also a broad responsibility in my office, each and every technology we work on singly has a spin-off and an application into other area that may not be directly

related to where it is targeted in our mission sequence. But, with all money that we can put in technology, if we select the right technologies, it benefits broadly in the years ahead.

In terms of a schedule, we do view the Space Exploration Initiative as a strategic horizon for NASA, and something to focus NASA's activities on in the years ahead as we go forward. In that regard, a schedule is not, in my view, the primary driving context. It's where are we going to go and how are we going to get there that, at least initially, drives the overall NASA strategy.

That is the strategy we hope to evolve as we come out of the studies of the Synthesis recommendations on architectures. I believe we will derive proposed plans, schedules, and budgets over the next several years as we focus on those.

In any event, we know enough about our planning requirements, our science requirements, and our technology requirements that we can start today on the right things and fund them in an appropriate initial phase as this program converges from these study activities.

Exploration-Related Role for Station

Mr. Sensenbrenner. There have been reports that the Synthesis Group may reject the use of the space station for assembling or servicing various types of craft in the lunar Mars mission. What exploration-related role does NASA see for the station, and how urgently is the station needed to support exploration?

Mr. Aldrich. The station has a very vital role to play in the Space Exploration Initiative. That is, to further our knowledge and understanding of life support, and life support systems in Earth orbit for long duration periods. I believe, personally, this is the primary key goal of the space station over the next decade to two decades. It will vitally address things that we must have in order to plan the systems and the missions to go out—not so much back to the Moon, perhaps, but certainly on to Mars and further in the solar system.

Mr. Sensenbrenner. You do not foresee the station to be either a warehouse or an assembly point for major hardware necessary to go to Mars, do you?

Mr. Aldrich. I think that's an open question. The specifics of the implementation of a number of architectures are driven by many things, many choices, and many inter-acting capabilities. I think it would be premature today to decide either that the station is required for in-flight assemblies and transportation, or that it is not. That is more mechanism which has cost, schedule, and implementation characteristics that need to be studied as these missions evolve. These are things that we don't know today to make such decisions on.

Mr. Sensenbrenner. We're going to be told next week about the down-scoping of the space station, pursuant to the mandate of the appropriations bill that was passed last year. My guess is that to do what you're saying is going to require an add-on to the space station after it is initially assembled. Is that a correct assumption?

Mr. Aldrich. My understanding of the re-scoped and re-phased space station activity, as will be proposed to you next week, is that

it will fully support the life science research requirements that I referred to. Also, I understand the station as it is currently conceived has the capability to be grown in the future into the kind of vehicle you might use, if you chose to, as a transportation mode. That would not be part of our planning today, nor of the station that would be presented for approval.

Mr. SENSENBRENNER. How does this fit in with Congress's either approval or failure to fund the heavy-lift vehicle that the Augustine Committee has recommended?

Mr. ALDRICH. I believe the station is a hard requirement for our future exploration missions to do life science work. I believe the heavy-lift vehicle is absolutely mandatory to boost the equipment, the facilities, the people, and their support that are required either for meaningful missions back to the Moon, or for missions beyond the Moon to Mars.

Mr. SENSENBRENNER. I have one final line of questioning I'd like to get you on the record on, Mr. Aldrich. The flight telerobotic servicer has been somewhat of a football, as we all know. It started out as a well-funded part of the station. Then when station costs increased, there was a proposal to privatize the construction of the FTS, but tab NASA as the only customer. That was more of an accounting trick than anything else. Now, the FTS is in your shop. What is going to be done with it now that it's there?

Mr. ALDRICH. In my Office of Space Technology, we, in 1991, have a $20 million program on artificial intelligence and telerobotics. We plan to fold the flight telerobotics servicer technology work that the space station has been doing that now would be transferred to my office into that program, and we are currently considering a range of options on how best to proceed to include those kinds of activities leading to a flight test to round out the telerobotics program we have already been working on.

Mr. SENSENBRENNER. The real key question is, is the cost of the flight telerobotics servicer going to reduce your budget for more pure research into telerobotics? As we know, the FTS is a rather expense piece of equipment. That's why it has become the football that it has.

Mr. ALDRICH. We will be planning an integrated program of telerobotics technology and FTS-related flight experiments. I think we will balance the funding appropriately to achieve the most important objectives.

Mr. SENSENBRENNER. I don't think that answered the question. I asked if the research was being reduced as a result of the expense of FTS being put in the Earth shot.

Mr. ALDRICH. In our 1992 plan that we've submitted in this budget, our research is not reduced, and it is proceeding as planned for AI and for telerobotics. We're looking at the telerobotics servicer as an enhancement and an augmentation.

Mr. SENSENBRENNER. How about in the out-years when we actually have to spend money to construct it?

Mr. ALDRICH. We'll need, by 1993, to tell you what an integrated and balanced telerobotics program would be; that has whatever features of the FTS strategy and planning are appropriate to round out our program. I look at our telerobotics program first as a tech-

nology program and, second, as a manifestation of the follow-on of the FTS as an operational system in the station.

Mr. SENSENBRENNER. Do you feel that we're making a decision on the FTS that we can't go back on if we agree to go ahead with the FTS part of this budget request? This means, are we stuck with it until completion in the out years, regardless of the impact on the more pure research part of your budget?

Mr. ALDRICH. We have not arrived at a single implementation plan to do the technology of the FTS as we are acquiring it from station. We have at least four options under study about how you would proceed to make the most sensible plan that would be a part of our overall technology program.

Mr. SENSENBRENNER. I would hope that you would share what those options are with the subcommittee before we mark-up a NASA Authorization Budget. I feel that we are about ready to embark on a one-way street on this one. Before walking down that street, I would like to kind of know where it leads us. Thank you very much, Mr. Chairman.

Mr. HALL. Thank you.

To follow-up on the Minority Leader's questions, if there is no real plan, what's the basis of the $55 million funding request?

Mr. ALDRICH. The $55 million funding request relates to the proposal to continue the FTS initial flight activity, which is a prototype FTS arm on a space shuttle flight several years from now. It's proposed that that be, in fact, the flight test program that we would carry forward and complete over the next several years.

Mr. HALL. That's subject to change?

Mr. ALDRICH. We're looking at the benefits of doing it exactly as I just described, and also other alternatives of flight experiment where we continue on the legacy of further work of in-flight experimentation with FTS-type systems, but not necessarily before we've had a chance to integrate whether our plans say exactly what the specifics of that program would be.

Mr. HALL. Okay, I'll get back to when that demonstration flight might occur and all that with you later, if I get any time. The Chair recognizes the gentleman from California, Mr. Packard.

OPEN-ENDED PROGRAMS

Mr. PACKARD. Thank you, Mr. Chairman. Let me get back to Mr. Sensenbrenner's first question regarding the open-ended programs tailored to meet the availability of funds. Since I have been on this committee, which has been during my eight years in the Congress, I have felt that the budgeting process—the funding availability has driven the projects and the programs. We've not been able to really do planning, irrespective of budget considerations. Now, I know that that's almost impossible to do.

At the same time, I think it would be very helpful if we were able to plan what the priorities are, based upon perhaps more than one budget consideration; one which we would like to have, and then one which we realistically expect that we'll get. Often we adjust in the middle of the stream, we downsize, we cancel, or we delay projects because the funds that we had hoped for don't come.

We end up going through a constant process of programming, replanning, and often re-orienting our priorities.

That is a constant concern for me, because I see us not utilizing even what limited funds we do now have for our space programs in an effective way. I'd like you to comment on that. If, in fact, there is an effort or will be, or could be an effort, or should be an effort, that would plan without requiring that the availability of funds be the driving force. These open-ended processes as recommended in the Augustine Report are a continuation of the process that has been a problem for me for a long time.

Mr. ALDRICH. I'd be pleased to comment on that. First, I would say that my view of "pay as you go" is not simply use of left-over available funds as you proceed. It's to strategize on a regular basis how much in the next incremental period should be dedicated and placed on the various stages in proceeding with SEI. So, in my view, it involves planning and strategy, but it doesn't try to plan, necessarily, a 30-year horizon, it more plans near-year horizons with specific interim activities and goals.

I think, in terms of SEI, we are doing that whether we say it or not. Two of the most important things we already mentioned for SEI are the new National Launch System and the Space Station Freedom. We're working very hard on schedules, targets, goals, and funding levels for those. SEI will not proceed ahead of those by any means. In fact, it needs to know their availabilities and capabilities as part of its longer range perspective.

Mr. PACKARD. I hope you understand what my concerns have been.

Mr. ALDRICH. If I can have more time, the second part is, it is our intent to analyze Tom Stafford's recommendations on architectures and technologies. Over the next several years, we will put together longer duration program plans, funding, commitments, and schedules as recommendations for what this program should be. The fact that we don't have it today is partly because we chose to gather more data and take more study time before we brought such activities forward.

TECHNOLOGY DEVELOPMENT FOR COMMERCIAL LAUNCH INDUSTRY

Mr. PACKARD. Thank you for that. As you know, one of my concerns has been in the commercial space program—the commercial launch services. This committee has been actively encouraging NASA to create a technology development program to support the commercial rocket industry in much the same way that NASA conducts its research to support the commercial aircraft industry. Conceptually, this program would develop new components, technologies, and procedures which, when applied to existing and new commercial launch vehicles, would make them cheaper, more reliable and more effective, in my judgment. Would you describe for us any specifics that you have done to create the program at NASA that would adapt itself to transferring of government funded R&D technology in support of the commercial launch industry.

Mr. ALDRICH. One of the Augustine recommendations is that we prepare a focused NASA technology plan for the future, and that we have external critique and review of that plan. We are moving

out to do that during this fiscal year and, hopefully, have enough lead on it that we influence the fiscal year 1993 budget process.

One of the efforts and focuses of that plan is to seek out commercial requirements for space technology, as well as NASA program requirements. We have intent to include both ELV industry recommendations and satellite communication industry recommendations as part of our overall plan to round out this full NASA technology program.

Technology Transfer

Mr. Packard. Are there still, in your judgement, existing impediments of transferring the technology development to the private sector?

Mr. Aldrich. In space technology, we spend some $50 million, I believe, on Earth to orbit transportation system launch vehicles. Large amounts of that technology is potentially directly beneficial to our commercial launch industry. However, because of the size and class of vehicles we tend to work on, there is a great extrapolation in development between what our technology is and the development of the real products that could serve directly in the ELV size, ELV class industry.

I think the issue that we struggle with is how far should we go on specific developments of systems and components for a different industry and a different purpose than the NASA program. That's what we need to look at and be more specific on in terms of what specific technologies we should do and how far we should take them towards the needs of the commercial industry, so that the kind of transfer you are talking about can, in fact, be achieved.

Mr. Packard. It's a sticky decision to make. I'm aware of that. Certainly, the taxpayers are not going to be able to fund all that we want to do in space. If we don't bring the private sector in as partners in our efforts to achieve our ultimate goals, then we simply will dilute our ability and certainly lengthen the time in which we will be able to accomplish those goals in space.

One last question, if I may, Mr. Chairman. Last October, an advisory panel to DOT, the Department of Transportation, of commercial space transportation published a report, COMSTAC Innovation and Technology Working Group Fiscal Year 1990 Final Report. That report, I supposed—at least it should be a very valuable tool in our efforts to develop the commercial launch industry. What is your observation of the report and what is being done with the report?

Mr. Aldrich. It is a valuable tool. We have discussed it with the Department of Commerce. It will be part of what we look at in the technology program assessments I just talked about, as will the report we provided to this committee on ELV commercial technologies during 1990. We think both of those products are very useful and focused. We need to draw in the people that are on the commercial side and discuss them in detail in working a plan and a proposal, and we plan to do that.

Mr. Packard. It's your intention, ultimately, to implement some of the recommendations in the report?

Mr. ALDRICH. Hopefully, funding permitting. One of the difficulties we've had in the past with other space technology objectives in commercial is the very tight and restricted space technology budget we've had to operate under for NASA needs. Even with clear vision of some of the things we would like to do, many of the programs and the priorities that we've had on the table have not been able to be achieved, because of the funding levels, and space technology has not been able to benefit from it.

Mr. PACKARD. Thank you, Mr. Chairman.

Mr. HALL. Thank you. I like to extend the gentleman's questions. If I understood you correctly, you intend to issue another report?

Mr. ALDRICH. No. We intend to use the report we provided the committee during 1990. We consider its recommendations and assessments still valid. We also plan to use the COMSTAC Report, which is done for the Department of Commerce.

Mr. HALL. The COMSTAC Report really laid out some suggestions and priorities, did it not?

Mr. ALDRICH. I believe it did, yes.

Mr. HALL. But in your report that you were directed to make in 1988—if I read it correctly, it doesn't say that you are going to develop such, but it says that if such a program were to be implemented, it would entail both government and private sector efforts and resources. Is there a follow-up to this?

Mr. ALDRICH. That's the report I'm referring to. It suggests the areas we think are still appropriate to be pursued that would be the technologies that would be most beneficial.

Mr. HALL. It doesn't say that you are going to develop any new component technologies?

Mr. ALDRICH. It does not say what the plan is, but it is a reference for the requirements, which is what I had meant to say.

Mr. HALL. Do you have a plan?

Mr. ALDRICH. We are working on the plan this year. It's Recommendation No. 8 of the Augustine Committee. It will be a larger and more focused technology plan than we've done in recent years. Particularly, commercial ELV will be a part of that plan.

Mr. HALL. Are you going to ask for funds for that then, for 1993?

Mr. ALDRICH. Hopefully, we will be able to digest this and get it on the table and ask it for 1993. I would like to say one more thing, though. In the aeronautics model, and the work we do in aeronautics for technologies that are used by the aircraft industry, we do not develop components for industry, or systems, or flight capabilities. We develop technologies and the industry converts those to the actual products that they build and operate.

Mr. HALL. I may not have read it correct, but it seems to me that you didn't indicate that you were going to develop any technology here. You just simply said that if such a program were to be implemented, then such and such. Have I not read it completely?

Mr. ALDRICH. No. That is the program we're now talking about implementing and doing the detailed work to characterize.

Mr. HALL. The Chair recognizes Mr. Henry.

SP-100 Program

Mr. Henry. Thank you, Mr. Chairman. I wanted to reshuffle the focus of discussion a bit and open up the issue of the SP-100 space nuclear reactor. Could you give us just a quick re-cap as to what the objectives of the program are, simply stated, and the participation of DOD and DOE with regard to how the project is structured?

Mr. Aldrich. This program has gone on for some number of years. Its objective is to provide reactor-based nuclear power for use in space. It targets the 100 kilowatt level of power output capability. It's managed by DOE, however the project office, in fact, is one of the NASA facilities, the Jet Propulsion Laboratory. Their project office has managed its efforts at a number of the DOE technical laboratories. Overall, Government management is overseen by a steering group, of which both the DOE and NASA and DOD participants are members.

Mr. Henry. In your stipulated objectives, which major milestones have you achieved and which have yet to be achieved?

Mr. Aldrich. We've achieved a number of milestones in terms of basic technology evolution and technology assessment. We've been through the design definition phase of what the reactor could be and should be. Specifically, now, we are working on the core technologies to evolve the specific components of that system.

Mr. Henry. Can you be more specific in terms in terms of what all that means? You are saying that you are working on it.

Mr. Aldrich. It's a multi-year program. It's probably a fifteen year program to evolve this capability and the systems tests and certification tests won't occur probably for another ten years. So, we're in the middle of a very detailed technology evolution phase of being able to produce the components.

Mr. Henry. I guess what I'm asking is if you move to a point where you're kind of a management by objective structure—A, B, C, D—how far along are you in that respect? In that sense, are you at a point of measuring whether your current schedule for the program—how it compares to your original schedule?

Mr. Aldrich. We have a series of detailed technical milestones each year. We're moving well through those milestones. However, based on the funding that we received for this program, both ourselves and DOE, over the last several years—last year we had to rephase and stretch out the program, based on funding, rather than technical progress. We have consistently over the years been funded at levels lower than the funding plan that targeted the original SP-100 long range schedule.

Mr. Henry. But you've not run into technical difficulties in meeting your scheduled deadlines—no major impediments technically? It's been the funding spread?

Mr. Aldrich. There are no major technical impediments, but there are still major technical challenges to complete. We're working forward successfully on our interim milestones.

Mr. Henry. When do you anticipate there will be a space-based test of the project?

Mr. Aldrich. Early after the turn of the century.

Mr. HENRY. What would be the total cost of the program, in your estimation, and how much of the total cost is NASA's responsibility? You're figured in for what, about $20 million?

Mr. ALDRICH. We have proposed $20 million this year. We have been roughly paying a third of the cost of the program, from year-to-year, although that varies, depending on how the different budget years play out.

Mr. HENRY. What, in total cost, do you anticipate?

Mr. ALDRICH. Let's see, do you know the total cost, Mr. Rosen?

Mr. ROSEN. The total cost of the program, when it was initially begun was about $500 million. Because of the run-out, and because of the fact that in no given year have we come close to the funding that was planned, that number has gone up considerably. I'd say it's probably of the order of $600 million.

With respect to the flight test you mentioned, that's not part of the program, Mr. Congressman, and at some point in time—the program right now is strictly a ground-based program. Some studies are going on to see and understand what a flight test would entail. At this point in time, that's not part of the program and we can't estimate that cost approximately now.

Mr. HENRY. From a theoretical prospective, why should this program be pursued instead of alternative approaches such as thermionics?

Mr. ALDRICH. Thermionics is a different specific technical manifestation of producing a very similar kind of system, although our assessment of thermionic capabilities, as we understand them today, tends to be effective in lower power ranges than we're hoping to achieve from this system. The SP-100, we believe, is more directly beneficial of the techniques—I guess we call them thermo-electric techniques—that it's based on.

Mr. ROSEN. There is also a lifetime issue with respect to thermionics. At the time the decision was made on what particular concept we'd use, it wasn't clear that the thermionics would satisfy the seven year requirement that the program had. That's still an issue at this point in time.

Mr. HENRY. I was just going to ask, conceivably, could it today, in terms of what we now know, or not, in your judgment?

Mr. ROSEN. I don't believe today, yet, that that's been satisfied—that thermionics, in fact, would satisfy the long-term goal. Seven years in a highly radiative environment is a very challenging issue.

Mr. HENRY. If solar dynamics became a technology development program in your office, would you be willing to sponsor a solar dynamics flight test?

Mr. ALDRICH. My office worked on solar dynamics technology for a number of years, up through 1984. At that time, we transitioned it to the program development phases of the space station. We see little benefit from additional technological work on the solar dynamics systems. There is one area that we do see a continued technology effort in, and we have already in our program—in our in-space technology program—a flight experiment related to that. In terms of other technology addressing the solar dynamic system, as characterized in the one that was to be used on the space station, we don't see a future technology of flight tests there beyond the one I mentioned being appropriate.

Mr. HENRY. So you're not planning on integrating—I'm not sure I followed you there. You are planning a flight test incorporating solar dynamic power systems on the space system, or you are not?

Mr. ALDRICH. We're not planning a flight test of a solar dynamic system. There is one area of technology in terms of the molten salt bed that is used to transfer the electricity back and forth—transfer the thermal energy back and forth to produce electricity that we think could and should have a technology program. We have that program in place. It will fly on the space shuttle several years from now.

In terms of an all out solar dynamic system, that technology work has been done. The station had no flight test planned, other than the flight itself. We don't believe a flight test would be beneficial or economically necessary.

UNIVERSITY RESEARCH PROGRAM

Mr. HENRY. I have one more question, if I may, Mr. Chairman. Following up on some of the opening questions of Mr. Smith, on your university research allocations. You are saying about 15 percent of your budget, either directly to the university research program, or indirectly through contracts, went out into the universities. I wanted to focus a bit more, if I might, on the university research program—the science and engineering research center program.

Mr. ALDRICH. We thought we were going to be about 20 participating institutions, but budget cut-backs affected that as well.

Mr. HENRY. What are the nine institutions that are directly participating in that program?

Mr. ALDRICH. Did you ask who they are?

Mr. HENRY. Yes.

Mr. ALDRICH. Massachusetts Institute of Technology; North Carolina State University, combined with North Carolina A&T University; Pennsylvania State University; Rensselaer Polytechnic Institute; University of Arizona; University of Cincinnati; University of Colorado at Boulder; University of Idaho; University of Michigan.

Mr. HENRY. Is deliberate effort being made in this sense to utilize this program to spread research-based interest and vitality across the university system, or is this program envisioned essentially to strengthen institutions that already have some premier capacity in space research, engineering, and science?

Mr. ALDRICH. My opinion is that there are two primary goals of this program. One is to increase the capability and, therefore, the scope of what these universities are able to do in space-related technologies and enable them to grow capabilities that don't exist today, not only with the Government, but also with industry.

The second objective is to increase the interest and advances of scientific education in the students at the universities through the mechanisms that are provided.

Mr. HENRY. Thank you, Mr. Chairman.

Mr. HALL. Mr. Henry, if you don't mind, to follow-up on your questions to Mr. Rosen—Mr. Rosen, I understood you to say that no flight testing program, correct?

Mr. ROSEN. That's right, at this time, there is no plan to fly an SP-100.

Mr. HALL. An SP-100?

Mr. ROSEN. That's right.

Mr. HALL. I have a letter from Admiral Watkins, the Secretary of Energy, dated January 11, 1991. I'm going to read a part of it. Tell me if that's consistent with your testimony. If it's not—if it is consistent, just say it is. If it isn't explain where it is not consistent.

It says, "Accordingly, the program"—and this refers to the SP-100—"Accordingly, the program is being changed from a two-phased effort involving ground testing of a reactor followed by a flight qualification phase, to one that will focus directly on a flight qualification system, with ground reactor testing to be done in conjunction with space qualification". Maybe I misunderstand the letter.

[The letter from Admiral Watkins follows:]

The Secretary of Energy
Washington, DC 20585

January 11, 1991

The Honorable George Brown
Chairman, Committee on Science,
Space, and Technology
U.S. House of Representatives
Washington, D. C. 20515

Dear Mr. Chairman:

The Department of Energy is pleased to submit the enclosed report of its activities under the SP-100 Space Reactor Power System Development Program, which is now in its second phase--Technology Readiness. In 1983, the House Committee on Science and Technology (now Science, Space, and Technology) requested that the Department submit semi-annual reports relating to activities in the SP-100 program. This is the thirteenth semi-annual report we have submitted in response to that request.

Excellent progress has been made in the last 6 months and is anticipated to continue into the future. However, the severe FY 1991 funding reductions imposed by Congress have contributed to the need to undertake a major restructuring of the program. The total appropriated funds from the three agencies (Department of Energy, Strategic Defense Initiative Organization, and National Aeronautics and Space Administration) were reduced from $91,000,000 to $50,000,000.

Accordingly, the program is being changed from a two-phased effort involving ground testing of a reactor followed by a flight qualification phase, to one that will focus directly on a flight qualification system, with ground reactor testing to be done in conjunction with space qualification. Under this approach, the ground test will be deferred until 2001, but the space qualification test that provides a system ready for space use will be completed several years earlier than with the original program logic.

Despite these changes, user commitment to the program remains strong, with the United States Air Force also becoming more actively involved in support for the SP-100. An Air Force General Officer has joined the Department of Energy, the National Aeronautics and Space Administration, and the Strategic Defense Initiative Organization on the SP-100 Steering Committee. The independent high-level program review referred to in our last report has now been completed, and its recommendations have been considered by the SP-100 Steering Committee in restructuring the program.

Our efforts on this program to date have led us to believe that nuclear power remains the only reasonable alternative for supplying the higher power levels needed for important space missions of the future. These missions will include communications, surveillance, nuclear electric propulsion, and power for a lunar outpost. In addition, nuclear power may be an enabling technology for the President's Space Exploration Initiative (SEI), so it is important at this stage to maintain the viability of the SP-100 program while the Nation debates its plans for future space accomplishments. Accordingly, the Department is pleased to report that this important program continues to make significant technical progress, and with the addition of the United States Air Force to the Steering Committee, user commitment not only remains firm, but has increased.

Sincerely,

James D. Watkins
Admiral, U.S. Navy (Retired)

Enclosure

Mr. ROSEN. Mr. Chairman, there is no approved program that includes a flight test at this time.

Mr. ALDRICH. Let me add to that. The term "space qualification" means ground tests to qualify the system so it can then be flown in space. In the several places there where he talks about space qualification, he is talking about ground systems testing, to qualify it.

Mr. HALL. You've seen the letter?

Mr. ALDRICH. I haven't seen it recently.

Mr. HALL. I'll be glad to give you a copy.

Mr. ALDRICH. That is a term that is broadly used in our program terminology.

Mr. HALL. That statement in that letter dated January 11, 1991 is it inconsistent with what you suggest, Mr. Rosen?

Mr. ROSEN. What I'm saying is——

Mr. HALL. Just tell me it's not inconsistent and I'll go on to the next—and then I'll give you the letter and let you, you know—be a little more fair with you and let you read the whole thing.

Mr. ROSEN. It is not inconsistent.

Mr. HALL. The Chair recognizes Mr. Rohrabacher of California.

NASP

Mr. ROHRABACHER. Thank you, Mr. Chairman. I would just like to again compliment Mr. Aldrich and his office for the fine work that you've done on the National Aerospace Plane Program and the other projects, and again, the two gentlemen that I complimented at Ames. That's about all I have to say, Mr. Chairman. Thank you very much.

This operation, in terms of NASA, I find that we're really talking about a research area here, and I find this is the type of thing NASA should really be doing. This is the space work or laying the ground work for technological progress. I find the work you are doing is not only acceptable, but exceptional. So, not only do I think you are doing a good job, I think you are doing an exceptional job. I appreciate your testimony today, and that's all I have to say, Mr. Chairman.

Mr. HALL. That's the least I've heard you have to say in a long time. [Laughter.]

Mr. ROHRABACHER. Yes, sir.

Mr. HALL. All right. Because you usually have something to say, and I think that that was something to say.

Mr. ROHRABACHER. Yes, sir.

Mr. HALL. Mr. Cramer, of Alabama, I recognize you for five minutes.

AERO-ASSIST FLIGHT EXPERIMENT

Mr. CRAMER. Thank you, Mr. Chairman. I would like you to speak on the aero-assist flight experiment. I know that that is a program that started in 1986 that has had a number of problems with it. Its budget has been doubled; it's launch date has slipped by four years. How important is that test?

Mr. ALDRICH. I, personally, believe that is one of the very important technologies and, therefore, flight tests in our program. It's regrettable to me that both in 1991 and 1992, we've had to delay the

schedule on it because of funding priorities. It's an important competitor for our exploration missions.

Certainly, we want to pursue nuclear propulsion as a primary way to do space exploration missions, and as a competitor with chemical engines to use chemical engines in combination with aero-brakes to fly both Moon-related and Mars related mission technologies—mission approaches. Those technologies all, I believe, need to be pursued aggressively in this time frame so we can make wise decisions downstream on what's really available and what will really benefit us.

Mr. CRAMER. How much confidence do you have that this project is now under control?

Mr. ALDRICH. I believe, in a funding sense and in a technical sense, it's well under control. Unfortunately, the schedule, strung out as long as it is, is not optimum. I prefer to see programs that can be done more expeditiously and be accomplished and be put behind us.

Mr. CRAMER. Is there any cheaper way to do this test?

Mr. ALDRICH. I don't believe so. It's a very complicated test. It involves some very elaborate equipment. It has 11 very key experiments that are part of acquiring the data that we need in order to understand what the meaning of it is.

Mr. CRAMER. Why must it be done now?

Mr. ALDRICH. It needs to be done in this time frame because it is one of the competing technologies for transportation for SEI. It's an initial step. It talks about aero-brakes that would be used in conjunction with lunar trajectory velocities. These are quite likely follow-on programs that will be needed as we address Mars-range—Mars mission velocities and also Mars atmosphere-type aero-brake requirements.

It's a first step and it's very important. We've never done anything quite like this before. We need it, both to improve our ground models and to set the stage for what needs to be done downstream in that technological discipline.

Mr. CRAMER. Thank you very much. Thank you, Mr. Chairman.

Mr. ROSEN. Mr. Cramer, could I add something to that.

Mr. CRAMER. Yes.

Mr. ROSEN. Unfortunately, there has been a lot of discussion over what, I believe, is a misinterpretation of one of the real benefits of AFE. There is a lot of discussion that there is a competition between AFE and nuclear chemical-based rockets with AFE and nuclear. I think there is certain applications for AFE, which are in no way in competition. The major application is on our return from the Moon. We have no plans to develop a nuclear-based engine for a return mission from the Moon.

The benefits of nuclear would be from the Mars mission. Yet, an aero-brake capability in that mode would be extremely effective. So, one shouldn't compete AFE on a place where it doesn't compete so well and only give it half its credit where, in fact, somewhere else, it's almost unique. I think that one particular mission is a place where it's unique.

Mr. CRAMER. Thank you, Dr. Rosen. Thank you, Mr. Chairman.

Mr. HALL. You had a lot of problems in that program, probably with OMB and Congressional cuts. You've also had a budget that

you've seen double, have you not, since the start of the program? What causes that? What causes the budget just to go from $159 million to $345 million on a program like this?

Mr. ALDRICH. The initial estimate was based on the Phase A assessment of what the program could be. It's a very complicated technology. I believe that as we further understood what needed to be done, how it would need to be done, what experiments were required, and what data systems were required, really the scope of the program was better defined. When that was costed, that was really what the growth was attributed to.

Mr. HALL. Was the additional cost estimate—did that contribute to the slippage by four years of the launch date, or is it just a matter of priorities, or was technology the problem of—go ahead.

Mr. ALDRICH. The date we now see, 1996, is a several year slip. It's directly related to funding availability in 1991 and 1992. The prior schedule delays, I think, relate to program understanding and program maturity of the same kind that I described relating to the cost growth.

Mr. HALL. Mr. Rosen.

Mr. ROSEN. There haven't been—two years ago, we had a major review with the Administrator of that program. At that time we came up to a figure of $304 million or $305 million. There has been growth since then in the program. None of that growth has been due to any technological difficulties with the program. That growth since that point in time—since after the Phase B study—was due only to the program slippage.

Mr. HALL. Well, I used the illustration a lot of times of the little bitty television set. They came out with the first ones that were about four inches wide and two or three feet by four foot of the back-up. We could have waited until now and just had one big screen, but we would have been denied use of it all this time.

I'll say that as a lead-in to my next question. Just as on the space station, we probably would have been better off had we not done the planning, the appropriating, and the spending up to this time, because we are changing the design, changing the thrust. Well, in this program, should we have waited to start the program until we did understand the cost of the technology a little bit better? In looking back, it's easier to look back than it is to have looked forward at that time, but is that a reasonable statement?

Mr. ROSEN. I think the program was a $300 million program from day one. I just don't think we understood that until we had gotten through Phase A and Phase B to the point where we had everything well defined to understand exactly what was involved.

Mr. HALL. I like a happy ending to anything, and I note in my papers here it says, "NASA—the program is under control". The Chair recognizes Mr. Bacchus of Florida.

CRITERIA FOR CHOOSING SPACE ENGINEERING RESEARCH CENTERS

Mr. BACCHUS. Thank you, Mr. Chairman. Mr. Aldrich, I would like to return to several of the issues that have been discussed briefly earlier.

First of all, in your discussion of the university space engineering research centers, of which there are now nine, I'd appreciate—of

the list that you read—I didn't hear any universities in my favorite State or in my Chairman's favorite State on that list. I wonder, what were the criteria from which the particular universities were chosen for these centers?

Mr. ALDRICH. There was a very extensive criteria to cause these universities and many others to compete against, which they did. At the time of that competition, some number—20 or more—were selected as final competitors by a very independent, very rigorous outside review body to show no bias or no preference in the selection, other than technical capability and worth of the proposals. That was subsequently boiled to the number which we were able to select with the initial funding, which were the nine universities. That selection was conducted by NASA, but by no means was driven solely by NASA prerogatives or choices. It was a very extensive competition, based on merit of proposal.

Mr. BACCHUS. You had intended to have 20 of these centers, is that correct?

Mr. ALDRICH. Yes, and we still intend to have 20.

Mr. BACCHUS. What are the short-term plans and long term plans for expanding this network of centers?

Mr. ALDRICH. The priorities for technology funding in my budget in 1991 and 1992 are precluded by the additional funds to move from 9 centers to 20. We hope in the very near future to take the next step. This is to have an another announcement, another competition and selection, hopefully, of the additional 11 universities to round out that program as we intended.

FTS

Mr. BACCHUS. Returning to the flight telerobotic servicer, the FTS, I noticed your statement earlier—and correct me if I misstate what you said—that in certain respects, you view the FTS as first, a technology program, and second, as an operational system.

I'm one of those people who is very concerned that we haven't done all that we could and should have done as a country to develop robotics, and that some of our competitors are leaving us behind. I see tremendous potential in terms of commercial spin-offs from developing robotics. At the same time, I'm wondering what the mission for the FTS would be.

As I understand it, originally, it was intended to be part of the space station, and there would have assisted astronauts as they engaged in maintenance and repair, and conducted other chores. Now that we're going to a symbol more of the space station on the ground, supposedly, there is not as much need for it up there, so they shifted it over to you. Is that correct?

Mr. ALDRICH. The proposal has not been to shift the FTS system to me, it has been to take the technology aspects of that program, which is a small subset of the total program, and transfer that to my organization where it can be combined with a fairly significant ongoing telerobotics activity.

Mr. BACCHUS. What are the implications of that, bureaucratically and for the future of the FTS?

Mr. ALDRICH. Let me say a couple of things. I agree with you on the importance and the need for technology for telerobotics and ar-

tificial intelligence. They are several of the most important technologies for our long range horizons in SEI and in other missions. We're working, at the pace we're able, to achieve approval of such programs, strongly in telerobotics, at a number of our centers and at several very strong university programs.

The politics, if I can use that term, of the FTS is that that was considered to be an operational system of the space station, which was being developed at a fairly high funding level to do operational jobs related to assembly and maintenance. The station, in part of their down-scaling and restructuring, both in terms of program and cost, no longer believes that they can justify the need for that system, or what is required to implement it. Therefore, they have stopped their plans to proceed forward to develop FTS as part of the station.

The proposal in our budget is that the key technology efforts that have led to the evolution of the FTS to date, including an initial flight test of a prototype, could be transferred to Code R and will be transferred to Code R in my organization, OAET, and will be combined with the telerobotics program I have ongoing.

So, at the top of the comment I made about looking at the several ways we can proceed to implement that as a proposal, take the FTS prototype system, called DTF-1. This was to fly in 1993. We wish to continue to develop that prototype only, both in terms of ground hardware and ground tests, and then to fly it on the space shuttle, either in the same time frame or close to that time frame, as a flight experiment to validate telerobotic technologies and acquire data to compare to our ground system technology and research.

Mr. BACCHUS. When is this demonstration contemplated?

Mr. ALDRICH. It is contemplated in the space station program to be done in 1993. I think, as pulled out of the large total FTS program, which will be not carried forward, we're looking now at what that part of the FTS alone would be in terms of implementation of schedule. I believe it is possible that it could be flown in 1993. I think it might be delayed one or several years after we understand the full flow of the schedule in that regard.

Mr. BACCHUS. If we're not going to use the FTS on the space station, at least not initially, what will it be of use for? What are its potential uses? Why is it worthwhile?

Mr. ALDRICH. It will be the most sophisticated telerobotic robot that we will have flown in space—an American robot on United States hardware that we will have flown in space. In performing the tasks that we will perform in space in zero gravity remotely, the data that can be taken from that experiment can be compared directly to our ground design laboratory work and our ground simulations to validate the math models and the capabilities, as we understood them, in the evolving ground technology program.

Mr. BACCHUS. Are there potential commercial spin-offs to this research?

Mr. ALDRICH. There is a wide application of robotics already in industry worldwide, not just in this country. It uses systems similar to this. None of them are designed to operate in zero gravity or to perform the kind of spacecraft-related tasks we talked about, but

there is a great correlation between evolving industry capabilities in systems and the features of this system.

Mr. BACCHUS. Let me rephrase the question, and this will be my final question. Obviously, there is potential in terms of space exploration for using this type of a device. Are there potential commercial spin-offs here on earth?

Mr. ALDRICH. My opinion is that where we are with the FTS, it is more applying developed commercial capabilities that exist to spacecraft requirements in terms of materials, weights, and operational modes that are vastly different than what you see in our commercial industry.

Mr. BACCHUS. So this potential is primarily space-related?

Mr. ALDRICH. Yes.

Mr. BACCHUS. Thank you very much, Mr. Aldrich. Thank you, Mr. Chairman.

EFFECT OF STAFFORD REPORT

Mr. HALL. Thank you. There are a few things that have not been asked. Let's just try to get them for the record, if we can.

I'll talk to you a moment about the budget. As you know, the Synthesis Group will have their report and there will be some alternative approaches as to human exploration of the Moon and Mars when it issues its report next month. Let me ask you about the budget. Your request—how are you going to handle that? How much attention are you going to pay to the Stafford Report? If they make suggestions that show some things that indicate a higher priority than your planned program, will you amend your budget, or just switch around the priorities? Is the budget that you have just a placeholder, as you await the Synthesis Report?

Mr. ALDRICH. Our 1992 budget request has $15 million for mission studies and it has $52 for key technologies. We believe that budget is adequate to do exactly the right things with the Synthesis Report, which is work them hard, understand them, and develop those architectures so that we can see them in the proper context and framework for decision later on.

Mr. HALL. So, really, you think it's an adequate budget, but it is really actually a placeholder? You'll make those decisions after you see the report, sift through it, analyze it, compare it with what you've already planned, and then set your priorities?

Mr. ALDRICH. No. It's not a placeholder. The planning and priorities are downstream of 1992. This is the right budget to do the 1992 work, and it will do full justice in incorporating the Stafford Synthesis outputs into our plan and making them the focus of our activities during that year.

Mr. HALL. But if the Synthesis Group indicates they are of higher priority then, of course, you'll adhere to that, if you agree with them. Is that right?

Mr. ALDRICH. Yes.

HEAVY-LIFT VEHICLE

Mr. HALL. Let's talk about the heavy launch vehicle. What size—what payload capacity will you need for SEI?

Mr. ALDRICH. We've done a number of studies in the past of SEI launch vehicles. Those studies imply a class of 150 metric tons for—rather, 150,000 pounds for our lunar-based technologies and some 300,000 pounds for Mars. I'd like to ask Mark Craig to say more specifically, though, that answer.

Mr. HALL. I'd like to know what you need and when.

Mr. ALDRICH. When is a more difficult question because it relates partly to studying these architectures from Stafford and laying the plans, so the "whens" are early in the next century. In terms of years, we are still going to be assessing that. Mark, could you give us some of the real numbers?

Mr. HALL. State your name and your position.

Mr. CRAIG. Yes, sir, my name is Mark Craig. I'm the Special Assistant for Exploration.

Mr. HALL. We recognize you, Mr. Craig.

Mr. CRAIG. The studies that we have done, and that I think will be reflected in the work of Synthesis also, show for lunar missions in the range of 130 to 150 metric tons, and for Mars missions in the range of 250 metric tons.

Mr. HALL. What is that in pounds?

Mr. CRAIG. It's in the range of 250,000 to a little under 300,000 pounds for the Moon, and in the range of 450,000 or 500,000 pounds for Mars.

Mr. HALL. Thank you very much.

Mr. CRAIG. Yes, sir.

"MINI-ROVERS" TO MOON/MARS

Mr. HALL. It's been suggested, and I can't tell you by whom, that we might have a number of relatively low-cost, what they call "mini-rovers" that might be sent to the Moon or Mars instead of the traditional plan of sending one large, very expensive rover. I want you to just discuss the merits of that, and whether or not you have discussed those, or whose suggestion was that. Do you know?

Mr. ALDRICH. The class of mission, I think, that's being referred to is what we call the robotic precursor mission to follow on missions with humans. They relate primarily to the Mars evaluations. We understand that robotic missions will play a major part in further understanding the Mars environment, the Mars landing sites, and the Mars atmosphere. How many robotic missions, what size they are, and whether there are a lot of small explorers or several big explorers is part of what we talk about when studying architectures to determine what makes the most sense, provides the most information, and has the most cost-effective approach.

Mr. HALL. Micro-technology and robotics could allow some radically different approaches to the unmanned exploration of the Moon and Mars, could it not?

Mr. ALDRICH. Yes.

Mr. HALL. Is that in the works?

Mr. ALDRICH. Yes. Those are in our critical technology areas.

Mr. HALL. So your office has investigated that approach and you have it under consideration?

Mr. ALDRICH. We investigated those technologies. We understand that approach. The studies to determine what robotic missions we

do are really yet ahead of us as we define the real programmatic architectures that would be proposed for these programs.

Mr. HALL. Do you think it is feasible and do you have any plans to test the concept?

Mr. ALDRICH. There are no plans at this time to test it. Depending on what the requirements are, when we look at it in detail it seems feasible. We'd have to see how it would play out in terms of detailed study.

Mr. HALL. The Chair recognizes Mr. Stallings.

NUCLEAR PROPULSION

Mr. STALLINGS. Thank you, Mr. Chairman. Mr. Aldrich, I'm somewhat of a proponent of nuclear propulsion over chemical propulsion. As I understand it, it's cheaper and it reduces the number of launches. Nuclear will increase mileage, it has less weight, and it will get us there quicker. Am I correct with that analysis?

Mr. ALDRICH. Nuclear propulsion provides a strong advantage, particularly to our Mars-class missions.

Mr. STALLINGS. Exactly.

Mr. ALDRICH. It certainly, assuming availability, allows us to have reduced vehicle weights and reduced weight launch to lowered orbit. It gives us more flexibility in trip time and in launch windows, and it gives us other operational flexibilities in mission planning over chemical systems. However, these systems don't exist today. They are going to require years of very intense technology development to put in place systems that we can use that are safe and environmentally sound, and are dependable enough to provide the performance we need. That's one of the reasons, and it's one of the most key technologies in our budget, and will be in our future proposals, as we go forward.

Mr. STALLINGS. I agree with that. I'm just curious as I look at the budget priorities, I find that a disproportionate amount is being spent on the chemical, as compared to the nuclear. I'm wondering if it would be wise to re-direct some of your chemical propulsion activities towards nuclear propulsion, for both lunar and Mars transportation.

Mr. ALDRICH. The budget there for 1992—the space-based engine is an engine that uses standard chemical systems. It relates primarily to what we call a tug, and it relates to transportation to the Earth to the Moon class range. It also relates to a technology program that is already funded and under contract through one of our research centers. It's a near-end technology that we need at the front end of missions for SEI, if we proceed with that plan.

In nuclear propulsion today, we haven't had a strong nuclear propulsion technology program in NASA for over 20 years. We need to start by studying what nuclear propulsion technologies are the most beneficial to pursue and put together program plans for implementation. The funding you see there is the very beginning of starting planning in conjunction with DOE and DOD about building a nuclear propulsion program. One that in years ahead will be quite expensive. The needs for it are much further out than the space-based engine needs, in terms of the missions that we need to be applying them to.

Mr. STALLINGS. Well, let me carry on, then. For lunar and Mars service operations, significant power obviously is needed. The environments, as well as other surface conditions, are significantly different than experienced in space; for instance, the carbon dioxide on Mars. What technologies are you going to investigate to meet these needs?

Mr. ALDRICH. I didn't quite follow that part. The power part of the SP–100 program we talked about for nuclear power relates directly to what we believe is needed for a lunar base as it evolves. It is also needed for both the flight missions and the bases at the Mars range.

Mr. STALLINGS. Maybe what I'm getting to in this nuclear propulsion area is are you pursuing multiple technologies or have you constrained funding to a single technology?

Mr. ALDRICH. We are proposing and working on a broad MOU with the Department of Energy to look at all technologies that might be applicable to nuclear propulsion. We'll be studying those over the next several years before we really know enough to focus in on a single or maybe even several technologies themselves.

Mr. STALLINGS. Of course, dealing with nuclear propulsion is a prime concern. What are you doing to ensure safe disposal of space nuclear and non-nuclear systems in case of an abort situation?

Mr. ALDRICH. We are pursuing designs of this equipment that would be totally safe in use, because they are totally inactive and not activated until they are already underway, out of Earth orbit. That is, the Earth launch to Earth orbit and the Earth orbit activities would be such that they would be safe because they were not activated.

Mr. STALLINGS. Thank you, Mr. Chairman.

Mr. HALL. When will the MOU be completed? Do you have a date on that, a time on it?

Mr. ALDRICH. We have an overall MOU with DOE now. We're looking at drafts in this time frame of a specific MOU with DOE on broad-based nuclear propulsion. It will be in the next two months that we will complete that, I believe.

ROBOTIC MISSIONS

Mr. HALL. Let me ask you a question and then I'll lob you a pretty easy one here in a minute. There is a lot of concern in the science community that moving the responsibility of lunar and Mars robotics missions out of the Office of Space Science and Application and into the Office of Exploration might lead to compromising the scientific objections of the missions in favor of the operational requirements of human exploration. That has also been testified to here by a panel here yesterday, in part. Where do you think the responsibility for the robotic missions should be located and why? That's not the easy one I was going to lob you.

Mr. ALDRICH. No, but I really should answer rather than what I think, I should answer what Admiral Truly has already undertaken as a plan. His plan is to create a new Office of Exploration with a new associate administrator that reports directly to him. As he does that and as he builds that office, he would deal with issues

like activities directly within the new Office of Exploration as opposed to within the other codes.

Mr. HALL. What would you advise him? [Laughter.]

Mr. ALDRICH. There are a range of science activities. Those that relate directly to SEI—those that really, no matter how SEI plays out, are a direct couple. If you take our current organization structure, which may or may not stay in place for many years, I would believe you would leave science missions that are not coupled to SEI and space science.

The ones that do relate directly to the SEI can be done in either place. Today, they are done in the Office of Space Science. It was proposed by the Augustine Committee to move them to the Office of Exploration. I think my opinion would be that you would couple the most directly supportive robotics science missions directly with the exploration responsibilities.

Mr. HALL. Mr. Rosen, do you want to add to or take from that, or differ with it?

Mr. ROSEN. No, Mr. Chairman, I think that is fine. [Laughter.]

I tend to try to agree with my boss as much as possible. [Laughter.]

Mr. HALL. Well, that gets me into the longevity part of my question. Historically, your office has been plagued with people who either didn't agree with the boss or found some problem within it. You've had unusually high turnover rates within the management ranks. You're to be complimented in that you've been there for more than a year.

Last year, we were told that in the previous 21 years, the Office of Aeronautics, Exploration and Technology had been headed by a total of 23 associate administrators. So, let's start off by complimenting you on your tenure. It's not like it was in World War II, after a mission, you remove the tailgunner. You've lasted longer than that, haven't you? And, you're still going.

Mr. ALDRICH. I've been there longer than a year and I'm still there today.

VACANCIES IN MANAGEMENT POSITIONS

Mr. HALL. Based on your participation here today, I think you'll be there awhile, because you've been very open and helpful with us. But, this morning, I looked at the January, 1991 edition of the NASA phone book and found that of the 52 senior management positions listed for that office, 6 were vacant and 9 more were filled by acting members. That means that 29 percent of your key management positions are in a state of flux. Obviously, you'd like to correct this problem, wouldn't you?

Mr. ALDRICH. We certainly are eager to build a strong NASA team and organization. Not only has Norm Augustine recommended that in mechanisms, but that is at the forefront of Admiral Truly's plan and intentions.

Mr. HALL. The easy one I'm going to lob you is, do you think that there is a causal relationship between the rapid turnover rate that I've alluded to here in the senior management ranks of this office and the historical tendency for this important element of NASA's

infrastructure to be underfunded? The answer is yes, there, isn't it? [Laughter.]

An easy yes.

Mr. ALDRICH. The Augustine Committee recommended that the space technology budget in NASA should be multiplied two to three times. They reflected a recommendation that has been made over the years a number of times by other review committees over the last decade, at least.

While I am in place and on duty, I can see the frustrations of the budget's for space technology and the plans that have been put together and advocated over the years, and the regular results in terms of how successfully we're able to fund and implement those programs. That could well contribute to the efforts and support of the people that have been in this job prior to my tenure.

Mr. HALL. We want to help you to cure that underfunding malady that stopped this entity. I join Congressman Packard and Rohrabacher who extend to you accolades for the testimony here today and for the job that you're doing over there. I guess there are no other questions.

I really thank you and Mr. Rosen for your assistance and for your testimony. We may have some questions that other members may want to submit to you. We'll submit those to you and give you a reasonable time to answer them, if we've missed anything that we're trying to put into the record here today. For that we thank you, and with that, we are adjourned.

[Whereupon, at 3:06 p.m., the subcommittee adjourned, to reconvene at the call of the Chair.]

1992 NASA AUTHORIZATION

THURSDAY, APRIL 11, 1991

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON SPACE,
Washington, DC.

The subcommittee met, pursuant to notice, at 9 a.m., in room 2325, Rayburn House Office Building, Hon. Ralph Hall (chairman of the subcommittee) presiding.

Mr. HALL. This subcommittee will come to order. We welcome our guests, of course, and say good morning.

Today we intend to complete the subcommittee's authorization hearings on fiscal year 1992 NASA budget request. Our focus this morning is on the Space Station Program, and we also intend to examine the potential role of the proposed New Launch System in support of the station.

While the past budget committee may have cut the Space Station Program yesterday, I think the Space Subcommittee still strongly believes in the importance of a permanently manned station, and we acknowledge the concerns raised by the National Research Council and the Office of Science and Technology Policy and we take them seriously and we have high regard for them. But as both of these groups acknowledge, there are some other important reasons to build a Space Station.

The main focus of today's hearing is NASA's recently announced restructuring plan. The plan appears to present a more affordable approach over the near term, and NASA and contract personnel should be commended for their hard work.

However, the restructuring may well define the ultimate success of the Space Station Program and will very likely define the station's capabilities for years to come. So we need to understand NASA's plans, especially how NASA plans to achieve a permanently manned station and do the vital life sciences work that is central the station's justification.

It may not be possible to provide all the answers Congress needs on the Space Station restructuring in this one hearing, and there be merit in an independent review of the restructuring. We need to be confident we are moving out on a well-designed, frugal, fiscally realistic program, and I guess that's the purpose of asking you, who are very important to us, and have many important things to do, to give of your time to us today for which we are very grateful.

At this time I recognize my colleague and the leader of this subcommittee, Mr. Sensenbrenner.

[The prepared opening statement of Chairman Hall follows:]

OPENING STATEMENT

by

Honorable Ralph M. Hall

April 11, 1991

GOOD MORNING. TODAY WE INTEND TO COMPLETE THE SUBCOMMITEE'S AUTHORIZATION HEARINGS ON THE FY 92 NASA BUDGET REQUEST. OUR FOCUS THIS MORNING IS ON THE SPACE STATION PROGRAM. WE ALSO INTEND TO EXAMINE THE POTENTIAL ROLE OF THE PROPOSED NEW LAUNCH SYSTEM IN SUPPORT OF THE STATION.

WHILE THE HOUSE BUDGET COMMITTEE MAY HAVE CUT THE SPACE STATION PROGRAM YESTERDAY, I THINK THAT THE SPACE SUBCOMMITTEE STILL STRONGLY BELIEVES IN THE IMPORTANCE OF A PERMANENTLY MANNED SPACE STATION. WE ACKNOWLEDGE THE CONCERNS RAISED BY THE NATIONAL RESEARCH COUNCIL AND THE OFFICE OF SCIENCE AND TECHNOLOGY POLICY, AND WE TAKE THEM SERIOUSLY. HOWEVER, AS BOTH OF THOSE GROUPS ACKNOWLEDGE, THERE ARE OTHER IMPORTANT REASONS TO BUILD A SPACE STATION.

THE MAIN FOCUS OF TODAY'S HEARING IS NASA'S RECENTLY ANNOUNCED RESTRUCTURING PLAN. THE PLAN APPEARS TO PRESENT A MORE AFFORDABLE APPROACH OVER THE NEAR TERM, AND NASA AND CONTRACTOR PERSONNEL SHOULD BE COMMENDED FOR THEIR HARD WORK. HOWEVER, THE RESTRUCTURING MAY WELL DETERMINE THE ULTIMATE SUCCESS OR FAILURE OF THE SPACE STATION PROGRAM, AND WILL LIKELY DEFINE THE STATION'S CAPABILITIES FOR YEARS TO COME. THUS, WE NEED TO UNDERSTAND NASA'S PLANS--ESPECIALLY HOW NASA PLANS TO ACHIEVE A PERMANENTLY MANNED STATION AND DO THE VITAL

LIFE SCIENCES WORK THAT IS CENTRAL TO THE STATION'S JUSTIFICATION.

IT MAY NOT BE POSSIBLE TO PROVIDE ALL THE ANSWERS CONGRESS NEEDS ON THE SPACE STATION RESTRUCTURING IN THIS ONE HEARING, AND THERE MAY BE MERIT IN AN INDEPENDENT REVIEW OF THE RESTRUCTURING. WE NEED TO BE CONFIDENT THAT WE ARE MOVING OUT ON A WELL-DESIGNED, FISCALLY REALISTIC PROGRAM.

I'LL NOW TURN TO MR. SENSENBRENNER FOR HIS STATEMENT.

Mr. SENSENBRENNER. Thank you very much, Mr. Chairman. The Space Station Freedom is in trouble. The Space Station Freedom is in trouble because the Appropriations Committee has continuously cut the appropriations. Last year there was a huge cut that was contained in the fiscal year 1991 appropriations bill. And there was a mandate that required NASA to redesign the station and come up with a downscoped station that could fit within the money provided by the Appropriations Committee.

What NASA is going to do today is tell us about that downscoping. But this hearing is held in the context and in the light of a National Research Council report that indicates that there are inadequate funds to do the essential life sciences research that was the justification of the station in the very beginning.

We have further bad news in that apparently the Budget Committee has decided to make further cuts in Space Station Freedom. That leaves this subcommittee in general and this member of the subcommittee in particular facing very, very difficult decisions. I have supported the program of Space Station Freedom since its inception. I have supported fully funding Space Station Freedom. I continue to support Space Station Freedom and I continue to support fully funding the project.

But there comes a time when this project has been nickeled and dimed to death, so that it cannot justify its scientific work. The Appropriations Committee may have done that last year and this downscoped station may be inadequate to do the job that a Space Station is intended to do and to justify the expenditure of billions of the taxpayers' dollars for that purpose.

I am absolutely convinced that if the Budget Committee recommendation ends up being adopted, that the Space Station will have been effectively killed. If that is the case then the Congress ought to be man enough and woman enough to say so and to stop funding the program completely so that we are not throwing good money after bad.

I hope that our very distinguished panel of witnesses from NASA will be able to address the questions. Question number one is, does the level of appropriations set forth by the Appropriations Committee last year in the fiscal year 1991 appropriation bill provide enough money for a station that can do meaningful and realistic scientific research? In other words, is the National Research Council's conclusion erroneous?

Question number two, if the Budget Committee ends up getting its way and there is another cut in the appropriations after the budget is adopted and the Appropriations Committee meets, have we then gone below the line where a Space Station cannot justify, through its scientific worth, the money that will be spent at the reduced level?

If either of those questions are answered in the affirmative, then I think it is incumbent upon this committee to bite the bullet and tell our colleagues in the House of Representatives that if we want to fund the station at an inadequately low level, we might as well zero it out to begin with, and not throw any more good money after bad.

However, if we want to have a manned Space Station—and I am convinced that the vast majority of the House of Representatives

and the American Public does want to see a permanently manned American Space Station in space, then we ought to spend enough money to do the job right. Those are the alternatives that are placed squarely before the committee. I am very happy that the experts from NASA can come and answer these questions today.

Thank you, Mr. Chairman.

[The prepared opening statement of Mr. Sensenbrenner follows:]

OPENING STATEMENT
OF
HONORABLE F. JAMES SENSENBRENNER, JR.

NASA Authorization Hearing
on
International Space Station Freedom
April 11, 1991

Mr. Chairman: Today we hold the Subcommittee's long-awaited hearing on the International Space Staion Freedom. I believe I speak for everyone in saying that this hearing will not give us the comfort level we hope for when spending $30 billion, but perhaps we can get enough information today to authorize the President's request of about $2 billion in FY92.

Mr. Chairman, I must express my personal disappointment that NASA was unable to honor our request for this hearing before our recess, when the National Academy of Sciences' distinguished Space Studies Board released a report that described the scientific capacity of the reconfigured space station as inadequate and costly for the science to be achieved.

Holding hearings might have helped lift the cloud hanging over the space station in the science community, and could have helped us help NASA relate to the American people the trade-offs undertaken in the reconfiguration. Unfortunately, the Subcommittee was not able to be brought in the wagon-circle around Station.

When first presented to this Subcommittee in 1985, this was a space station that provided a center of gravity for all NASA programs. The station was planned to be an earth and space observatory, a satellite servicing and spacecraft staging platform for exploration, a laboratory and even a manufacturing facility.

Over the past six years, at the same time we have seen capabilities decline and costs soar, we have heard louder and louder that Space Station Freedom is the next logical step in

the manned space program. I sympathize with that view but I'm concerned about it. The manned space program cannot promise so much at one price and deliver so little at another, at least not without a good explanation.

So, the burden is on you. Yesterday, we marked-up the NASA authorization without prejudice to the space station. Today we will know if our patience was worth the price and following this hearing consider our options for funding.

We are mindful that the reconfiguration you present today was requested by the Congress. My impression is that you have met the directives of the Appropriations committee to the letter, and the final product represents a compromise between what we want and what we can afford. The question remaining is whether the reduced space station is worth the increased cost.

I look forward to today's hearing. Thank you Mr. Chairman.

Mr. HALL. Thank you. The Chair recognizes the Chairman of the Science, Space and Technology Committee, the very distinguished George Brown of California.

Mr. BROWN. Thank you very much, Mr. Chairman. I have no opening statement. I merely wish to commend you for the excellent job you have been doing so far in reviewing these difficult problems. Thank you.

Mr. HALL. The Chair recognizes Mr. Zimmer for an opening statement.

Mr. ZIMMER. Thank you, Mr. Chairman. I share a number of the concerns of the ranking minority member, I have no prepared statement at this point, but I will press on these issues in the questions.

Mr. HALL. Thank you very much.

We have a distinguished witness list today, headed by J.R. Thompson, Deputy Administrator, and flanked by Bill Lenoir, Associate Administrator, Len Fisk, Associate Administrator, Dick Kohrs, and Robert Moorehead. I think if there are any questions on this panel, we have a group here that will be able to answer them.

At this time, J.R., we recognize you and thank you for your many appearances before this and other committees here and for your appearance here today. You may summarize or read your entire statement into the record, as you see fit.

STATEMENT OF JAMES (J.R.) THOMPSON, JR., DEPUTY ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, ACCOMPANIED BY DR. WILLIAM B. LENOIR, ASSOCIATE ADMINISTRATOR, OFFICE OF SPACE FLIGHT; DR. LENNARD A. FISK, ASSOCIATE ADMINISTRATOR, OFFICE OF SPACE SCIENCE AND APPLICATIONS; RICHARD H. KOHRS, DEPUTY ASSOCIATE ADMINISTRATOR, OFFICE OF SPACE FLIGHT; AND ROBERT W. MOOREHEAD, DEPUTY DIRECTOR, SPACE STATION FREEDOM PROGRAM AND OPERATIONS

Mr. THOMPSON. Thank you very much, Mr. Chairman. I do have a statement I would like to put into the record, and I would like to summarize my remarks.

I would like to take note first of the landing of the shuttle that we expect in the next hour. It will close out the first decade of operation for the shuttle program. Looking back, I think it has been truly remarkable and bodes well for the future.

But today we are not talking about the last decade, we are talking about the future of America's space program, and I believe the cornerstone of that is Space Station Freedom. The restructured plan represents five or so months of very dedicated work by the total NASA team, our contractors, and our international partners. It has been a very thorough review of the content, the cost, the schedule, all of the requirements to include transportation. This restructured plan we are going to be discussing this morning has been thoroughly reviewed by the NASA team, the OMB, as well as the National Space Council and is strongly endorsed by all of the above.

The plan we submitted to the Congress this March 20th represents the commitment of this Administration to leadership in space exploration for America. The plan meets the direction, the guidance and the requirements of this Congress, external review groups like the Augustine Commission, it is consistent with our National space policy and meets the international agreements we have structured with our partners.

The plan simplifies the hardware and assembly. It reduces the cost. It meets the requirements of the users. It reduces the transportation requirements. It reduces the EVA by some factor of two. It does not preclude growth, and we believe it represents the maximum return on the Nation's proposed investment.

But I would agree with some of the earlier remarks. This is it for the Space Station. It is time that we all agree on the course we are going to set for this very important program and mileposts for the future. The program is clearly not a distraction. It employs some 30,000 people directly and an additional 75,000 people spread across America. It does represent, in our judgment, a world class microgravity and life sciences facility. It is the largest international, technological and scientific project ever undertaken, representing over $7 billion of foreign investment.

We also believe that it acts as a powerful inspiration for our youth and stimulates their interest in the math and sciences that are going to be very important in the upcoming century. We believe this program is fundamental to the U.S. leadership in science, technology and our competitiveness position, as we approach the year 2000. It is also crucial and key to the future long duration manned space flight exploration.

But I believe that to make the Space Station Freedom program a reality, we have to place the emphasis on implementing the program we are prepared to discuss with this committee today. We recommend no add-ons by NASA, our contractors, and we would encourage Congress to show the same restraint. The Space Station Program we are going to be discussing today can grow, it can evolve in the out years to be consistent with what the country can afford.

Today we are going to be talking about a credible plan, and we are at the head of the line to try to keep it that way. I think you have already introduced the quarterbacks of the program that we have at the table today. Mr. Chairman, what I would propose is for you to go directly to the questions we have. We have briefed your staff in considerable detail.

But before I do that, I would like to comment on some management streamlining. I think there has been a lot written on this. There have been a lot of rumors. The facts are that neither Admiral Truly nor myself, nor Bill Lenoir and his team, have come to any final conclusions on that. Our primary focus has been on the content of the program and the job ahead of us. Then we will be turning our attention very quickly to other measures we want to take relative to the management action.

What I would like to ask now is that if any of my colleagues would like to add anything, they may do so, then we will stand by for your questioning. Bill, do you have anything?

[The prepared statement of Mr. Thompson follows:]

Mr. Chairman and members of the Subcommittee:

I am pleased to be here today to discuss the newly restructured Space Station Freedom program and the fiscal year 1992 budget request. A number of important developments took place in the Space Station Program this past year. The three most important of these were completing the Preliminary Design Review (PDR), which included efforts to reduce weight, power, and EVA (Extravehicular Activity) maintenance requirements; restructuring the program to fit within a new budget profile as mandated by Congress; and responding to and implementing recommendations made by the Advisory Committee on the Future of the U.S. Civil Space Program. Each of these developments were important in and of themselves, but they were made more significant by the fact that they were all closely linked. Taken together, these developments represent a critical step forward at a pivotal juncture in the program. The success we have had in all these areas provides us with an opportunity to forge ahead with a more sound, focused, and, yes, more resilient Space Station.

Preliminary Design Review

1990 was the year of the Preliminary Design Review. The PDR is essentially an early check of preliminary designs at a point when designs are approximately 10 percent complete. The specific objectives of the PDR were to: Ensure that the design of every system and subsystem meets the stated requirements; verify the safety and operational adequacy of the integrated design; confirm the compatibility of the physical and functional relationships of the integrated design; assess the preliminary design for its ability to be produced, integrated and verified; assess design maturity; assess modularity of systems and elements to support the reference assembly sequence; and assess the integrity of each stage. The PDR process identified several areas of concern that were evaluated and resolved during the process.

The PDR was completed on schedule on December 20, 1990. Its completion served two important functions: 1) it validated the Space Station's baseline design, and 2) it provided a firm foundation and became the point of departure for the congressionally mandated restructuring assessment. The PDR was our number one priority last year. Its successful completion greatly enhances our ability to quickly and effectively implement the restructured program. The PDR consisted of two phases: the incremental reviews of the individual system and subsystem preliminary designs conducted at the Work Package centers followed by the review of the integrated system preliminary design conducted by the Space Station Program Office in Reston, Virginia. The incremental PDRs revealed two major areas of Space Station Freedom designs that required closer scrutiny: external maintenance and weight and power resource allocations. The results of these activities are outlined in detail below.

External Maintenance Task Team

In support of the PDR process, we conducted a number of special studies. For example, in December 1989, we formed the External Maintenance Task Team (EMTT), headed by Dr. William Fisher and Charles Price. Its subject was potential problem areas related to external maintenance on the Space Station. In June 1990, we formed the External Maintenance Solutions Team (EMST) to complement the EMTT and to address specific Space Station external maintenance problems.

The EMTT final report and the independent, companion EMST report released in July 1990 concluded that, with implementation of certain recommendations, maintenance related EVA could be reduced to one EVA every 8 to 10 days during mature Space Station operations of the program. This contrasts with raw estimates as high as 5 EVAs per week just six months earlier.

The EMTT's efforts also provided a more thorough understanding of assembly related EVA requirements and led to substantial reductions in these requirements during the restructuring assessment. The understanding obtained from both the EMTT and the EMST was heavily utilized throughout the recent restructuring assessment and will be covered in additional detail later in this statement.

Weight and Power

In June of 1990, we had found that Space Station weight and system power requirements were significantly over their allocations. We initiated a resource allocation evaluation effort to understand the problem and determine appropriate solutions. In three months, the effort had reduced program weight and system power requirements to within the baseline allocation.

In this activity, Space Station assembly complete estimated weight requirements were reduced from 656,000 lbs. in May to 526,000 lbs. in October, a reduction of 20 percent. Some specific examples of weight saving changes included: simplification of the Thermal Control System configuration; battery reduction of one third; integration of O_2/N_2 supply and storage pallets; weight optimization in inclusion of 6.25 kW Direct Current to Direct Current convertor; reduction of the power distribution system; scrub of the propulsion module attach structure; and several others.

In a similar manner, housekeeping power requirements at assembly complete dropped from an estimated 59.9 kW in May to 47.4 kW in October, more than a 20 percent reduction. Some of these savings have come from: lab equipment duty cycle modifications, data management system architecture scrub, and manned system power reductions. The vigor with which we attacked the power

requirements issue illustrates our commitment to providing the users with the power they need to conduct their research. Both the user community and the international partners were heavily involved in this process.

With the resolution of these major issues, the Integrated Systems Preliminary Design Review (ISPDR) went very smoothly. The ISPDR identified some discrepancies in the areas of integrated performance, but none required major design changes or cost increases.

In addition to validation of designs and resolution of several operational issues, through the PDR process, significant progress was made in a number of development areas. These accomplishments are highlighted below.

Restructuring Assessment

The restructuring assessment was mandated by the 1991 Appropriations Conference Committee Report. Specifically, it directed NASA to:

- Reduce the FY '91 budget by $551 million to $1.9 billion
- Revise the Space Station design and assembly sequence, reflecting an incremental approach where each phase is sufficiently independent to achieve on-orbit operation without the next phase
- Assume annual funding profile growth of 10 percent per year
- Assume peak year funding level of from $2.5 to $2.6 billion
- Plan a first phase devoted to micro-gravity followed by a life science emphasis and permanently manned capability
- Base the program on a "realistic" Space Shuttle launch rate
- Allocate $106.3 million for development of the flight telerobotic servicer project
- Allocate $10 million for solar dynamic power research
- Allocate no funding for an assured crew rescue vehicle

In addition, the following past congressional requirements applied:

- A fully equipped laboratory module before the habitation module
- A requisite number of utilization flights during man-tended operations
- Life science and centrifuge equipment outside of U.S. lab module
- 75 kW of power (if all phases are developed) with at least 30 kW of power available to the users

The restructured program plan that we will discuss with you today meets these guidelines and follows the spirit of the recommendations of the Advisory Committee on the Future of the U.S. Civil Space Program, as well as the 1989 National Space Policy. It honors our international commitments. And, it provides a quality facility to conduct the life and materials science research and technology

development proposed by the user communities. Space Station Freedom's capabilities for carrying out life science research on the effects of long duration space flight will be a central element in NASA's preparation planning and eventual implementation of the the Space Exploration Initiative. In sum, the restructured Space Station program provides an innovative and balanced plan for development and deployment of an orbiting manned base for the U.S. and its international partners. Unfortunately, with a budget reduction on the order of 22 percent, some reductions and delays in capabilities were unavoidable.

This plan has been developed by the program's civil servants, program contractors, NASA user program offices, and the international partners. The task was not a simple undertaking and could not have been completed without the complete dedication of all those involved. It was conducted through iterative reviews involving the field centers, the program office and headquarters, including Administrator Truly. The user program offices and their advisory committees were also closely involved in the process. The restructured program plan rests on the successful completion of the Preliminary Design Review (PDR), completed last December, which provided a firm foundation from which to proceed with the restructuring assessment. The restructured design reflects the optimization of several alternative configurations and system designs proposed by the contractors and NASA centers. In addition, independent cost estimates were provided by the contractors, NASA projects, Space Station Program Office, and NASA Headquarters and synthesized into a final recommended budget.

We have also maintained our international agreements, and minimized the impacts on the partners' costs and on their schedules, consistent with the impacts on our hardware schedules. The international partners were fully involved in the restructuring process and have written Administrator Truly strongly endorsing the restructured program plan and urging him to proceed with its implementation.

We plan to have the resulting changes in place by May and will perform a stage design review early in the next fiscal year to assess the impact of all changes made to the baseline program. Most of the decisions made during the restructuring had the effect of simplifying the baseline design.

Program Plan

Let me briefly summarize the program plan as a result of completing the baseline PDR and the subsequent restructuring assessment. We will begin assembling the Space Station in the second quarter of Fiscal Year 1996. We will achieve a man-tended capability in the third quarter of FY 1997 and a permanently manned capability with a four-man crew in FY 2000. These two independent steps constitute the initial phase of the restructured program. We currently plan an assured crew return vehicle available at permanently manned capability, and a 2.5

meter animal centrifuge to support life sciences will be in place at or very shortly after establishment of permanently manned capability.

Given the new program milestones and the proposed funding profile, the follow-on phase of the Space Station Program will include another solar array to achieve 75 kW and an eight man crew capability, and could include additional capabilities such as a second preintegrated laboratory and additional nodes. This phase would use the new launch system if it is available

Among the many changes which will simplify the technical and operational aspects of the Space Station, the change from an erectable to a preintegrated truss assembly is probably the single most significant change. It dramatically reduces EVA requirements for the assembly process by allowing truss assembly and verification of the individual launch packages on the ground. This change resulted in a 50 percent reduction in assembly EVA requirements, and a 40 percent reduction in maintenance EVA requirements. Additionally, the number of cargo elements i.e., the payload elements which attach to the Space Shuttle cargo bay, required for assembly has been reduced by roughly 50 percent, dramatically simplifying and streamlining the ground integration process.

We also simplified the integration and verification process by shortening the laboratory and habitation modules from 44 feet to 27 feet. This allows preintegration and verification on the ground, thus reducing on-orbit intravehicular (IVA) integration and verification activity. The shorter and lighter modules can be substantially outfitted on the ground, checked out and directly installed on-orbit without requiring significant IVA transfer from a subsequent logistics flight. Our current planning is predicated on the Advanced Solid Rocket Motor (ASRM). We are developing our assembly and utilization profile allocating an additional 8,000 lb of lift capability (the remaining ASRM performance increase being allocated to Shuttle system improvements). The initial benefit will be to the U.S. laboratory flight where the module can be fully outfitted on the ground. If the ASRM is not available for this launch, we will plan another logistics flight immediately following the laboratory deployment in order to outfit it.

One approach for design simplification and cost reduction utilized Space Shuttle systems and subsystems where they could be adapted for use on Space Station Freedom. Examples included the TV cameras, communications systems, and the waste management system. It was also determined that some Space Station components could be reduced in quantity and size resulting in somewhat reduced, but still sufficient, performance. Examples of these changes include a reduction of on-board computers from 22 to 7, and a reduction in the size of power converters from 12.5 kW to 6.25 kW capability. The net effects of these changes are savings in weight, power consumption, cooling and development funding.

In the environmental control and life support system, the water loop will now be left open until PMC and the air loop will be closed during the follow-on phase.

Thermal loops in the station cooling systems were reduced from four to three, control moment gyros were reduced from six to four, and star-trackers from three to two. Each of these changes reduced the budget, weight, power, assembly, and maintenance requirements. Cost savings were also realized by deferring private crew quarters until after Permanently Manned Capability (PMC). The assembly sequence was altered to call for the launch of two nodes initially and to postpone the launch of the other two until the follow on phase. Additionally, one of the two planned cupolas was deferred indefinitely.

Other changes in the program were the simplification of the mobile transporter and the crew and equipment translation assembly which will now use a common track system. Largely because of the simplifications to the truss system, we were able to eliminate the external positioning system and the crew external work platform, reducing costs, upmass requirements, and management complexity.

Beginning in fiscal 1992, we plan to focus the FTS project on technology development and transfer it to the Office of Aeronautics, Exploration and Technology (OAET) as part of a broader automation and robotics activity. The restructuring assessment revealed that the need for the FTS in the earliest stages of Space Station operations was greatly diminished, due to changes in program schedule and element designs, particularly the truss structure. FTS robotics technologies, particularly the end-effector technologies, are of importance in the long-term for the Space Station and the space program generally and a flight test is still planned by OAET to validate many of the enabling technologies.

We have deferred work indefinitely on the Attached Payload Accommodation Equipment (APAE) and have terminated the contract and, as a result, eliminated Work Package 3. However, the program will have utility ports that can be used for small externally attached equipment. These utility ports will be located along the entire span of the truss and will provide power and communication links sufficient to operate and monitor small attached payloads requiring extended exposure to the space environment.

Despite the promises of solar dynamic systems, the level of effort for the project was not in line with program requirements or available resources. Therefore, no further development activities will be undertaken by the Space Station Program. The Office of Aeronautics, Exploration and Technology will conduct a technology test flight to obtain needed data on thermal energy storage materials needed for solar dynamic systems as part of the IN-STEP program.

We have made changes in our operations planning consistent with other changes made in the program. In some cases, we will rely on existing Space Shuttle facilities rather than build new ones, and in others, construction and outfitting of facilities has been delayed or scaled back. The new Space Station deployment schedule will allow delays in construction and outfitting for several facilities. At Kennedy Space Center (KSC), where most of the final verification and integration

will take place, the Space Station Processing Facility will initially have four checkout areas and eventually six instead of the previously planned eight. Processing manpower, logistics facilities, and depot maintenance at KSC will also be deferred. At Johnson Space Center (JSC), many new development efforts will be reduced as a result of the use of Space Shuttle facilities. Work on control center support development is one example. Additionally, training facilities at JSC will be reduced from four to two areas. Equipment for the Payload Operations Integration Center at Marshall Space Flight Center and the Payload Training Center will be deferred and existing facilities (Spacelab) will be modified to support the revised payload manifest. Program-wide, there will be an overall reduction in the quantity of flight spares consistent with the reductions in system and subsystem complexities and delays in the program schedule.

Throughout the restructuring process, we have kept our focus on the end objective of the program: to provide a viable capability for the users. The restructured Space Station provides that capability. We worked closely with the NASA User Program Offices to ensure we met their requirements which they recently revalidated under the guidance of their advisory groups.

Even in its early stages, it will have several times more research capability than any previous orbiting facility, U.S. or Soviet. Space Station Freedom will be the largest and most sophisticated orbiting laboratory ever built and operated. Its capabilities will enable users to derive far greater benefits from Space Station Freedom than they could from any other orbiting laboratory. Because the program has maintained the ability to add or upgrade capabilities in many aspects, the restructured Space Station retains a robust complement of research capabilities which can be upgraded as requirements dictate and funding allows.

One of the greatest advantages Freedom holds over other orbiting facilities is its ability to provide substantially more power to its users. This allows significantly more research equipment, some with unique high power requirements, to be on Freedom and operating at any one time. Power available to the users will initially be 11 kW and will be at least 30 kW by the permanently manned phase. This is roughly ten times that of Skylab and Spacelab and more than double the power available for science on the Soviet space station Mir.

Space Station Freedom will provide a high quality microgravity environment with the Shuttle docked and in the "free-flyer" mode. The man-tended capability (MTC) stage of the program strongly supports microgravity materials research and allows continuation and enhancement of Shuttle-based life sciences research. At MTC, there will be 15 user racks, each the size of a large refrigerator, available for experimentation equipment. If you visualize how much of today's micro-electronic equipment can be built into 15 refrigerator sized boxes, you can begin to understand the capabilities available to users. In the man-tended phase, the free flying time on Space Station Freedom will offer an excellent environment to conduct untended materials research such as crystal growth. When crews are on

board while the Shuttle is docked, materials science will continue along with the addition of life science research. At permanently manned capability, the station will provide full support to life sciences with addition of long-duration stay times and a 2.5 meter centrifuge. It will also continue to support microgravity research. User racks will increase to 28 available to the U.S. users providing a research capability comparable to nothing else planned or in existence today.

In the new flight sequence, we have allotted three utilization flights and up to four assembly flights per year on the Space Shuttle during the man tended phase. The follow-on phase of the Space Station program post-2000 will utilize the proposed new launch system when it is available. We believe this manifest is highly supportable and is consistent with the recommendations provided by Congress and the Advisory Committee on the Future of the U.S. Civil Space Program. We have added an assured crew recovery vehicle to the permanently manned phase of the program.

In the restructuring assessment, data transmission capability was reduced from the previously baselined 300 Mbps to 50 Mbps to make use of "off the shelf" Space Shuttle designed systems. This is not an insignificant reduction, but by retaining the fiber optics communications links, the system retains the capability to enhance transmission rates to 300 Mbps or higher in the follow-on phase.

Finally, the restructured Space Station Program has put what was formerly known as Phase II planning well down stream. We realize the value of retaining a capability to increase resources and to provide new functionality to the users. Our current efforts are focused on identifying general design features which will provide flexibility for growth. We do not plan to commit to a specific growth design for several years, when specific requirements for future utilization, such as the Space Exploration Initiative, are better understood.

FY90 ACCOMPLISHMENTS

Work Package 1

Work Package 1 development activities take place at Marshall Space Flight Center (MSFC) in Huntsville, Alabama with Boeing as the prime contractor complemented by several supporting development contractors. They are responsible for the U.S. pressurized modules, associated systems, logistics elements, and payload operations.

In fiscal year 1990, Work Package 1 began initial welding on the conical end section for the pressurized modules. This activity is one of the initial events in the manufacture of the pressurized module standard Development Test Article (DTA). Construction and testing of the DTA will begin in May and will be used to evaluate and refine the manufacturing procedures for the pressurized modules.

The Work Package 1 team also completed testing of Temperature and Humidity Control (THC), avionics air cooling, and fire suppression hardware in August of last year. The THC testing demonstrated that average cabin airflow requirements could be met and dead-air zones could be minimized. The avionics air cooling tests demonstrated that various hardware cooling requirements could be met. Fire suppression tests determined CO_2 mixing rates and the time and quantity of CO_2 required to achieve effective concentrations.

Additionally, Work Package 1 completed comparative testing on the Environmental Control and Life Support System (ECLSS) in July. The systems tested and evaluated included an O_2 generator, potable water processor, hygiene water processor, and urine processor. The entire system was evaluated in terms of its launch weight, resupply weight, power, volume, maintenance, data management interfaces, hardware complexity, schedule, and risk. The tests validated designs and resulted in the selection of the Sabatier system for CO_2 reduction, the static feed electrolysis system for O_2 generation, the vapor compression distillation system for urine recovery, and the multifiltration system for potable and hygiene water. With the exception of three recommended subassembly design changes to reduce ECLSS weight, power and volume requirements, the testing proved that ELCSS designs meet their requirements. We are now proceeding into the development of ECLSS qualification hardware.

Work Package 1 also began pre-development testing of water recovery hardware with human test subjects in March. These tests capture perspiration, shower water and urine and will eventually have test subjects drinking and showering with recycled water. These tests are the first of several human interaction ECLSS tests serving as a pathfinder to flag key medical and safety issues associated with human testing while providing necessary test data for future design effort.

Work Package 2

Work Package 2 development activities take place at Johnson Space Center in Houston, Texas with McDonnell Douglas as the prime contractor complemented by several supporting development contractors. The Work Package is responsible for the central truss structure, resource node outfitting, various distributed flight systems, crew training, and flight operations.

Work Package 2 fiscal year 1990 accomplishments included the development of hardware for an EVA flight experiment which was flown on the Space Shuttle in the last few days. This equipment was used to: 1) evaluate three candidate concepts for the Crew and Equipment Translation Aid (CETA) cart, used to move astronauts and equipment along the truss structure; 2) evaluate tethered translation along the CETA rail using a Shuttle tether; 3) measure forces applied by crew to a portable foot restraint during use of EVA tools at a worksite; and 4) assess remote manipulator system stability as a result of crew induced forces. These tests will

provide valuable insight into the dynamics of the human/machine interface during assembly and maintenance EVAs. Additionally, hardware was delivered to JSC for the Space Station Heat Pipe Advanced Radiator Element II experiment to be flight tested this summer on the Shuttle.

McDonnell Douglas demonstrated the capability of a software-driven design to machine-produce a full scale airlock hatch. This hatch was then utilized to perform crew interface assessments and demonstrate the capability to seal the hatch in a pressurized node.

A prototype control moment gyro development test article was fabricated. This unit was subjected to testing by the vendor to establish the operational characteristics for engineering evaluation; e.g., bearing noise, power consumption, balance, torque, etc.

The medical development units were completed and delivered to JSC for testing and evaluation. The test results were used to define some crew health care system hardware concepts.

Other progress made in Work Package 2 included: Production, delivery and initial testing of a prototype fluid management system waste gas pump and rotary fluid coupler; and completion of a model and initial in-house testing of an inertial sensor assembly to demonstrate its functional characteristics.

Work Package 3

Work Package 3 development activities were managed through Goddard Space Flight Center (GSFC) in Greenbelt, Maryland. Included in this work package were the Attached Payload Accommodation Equipment (APAE) project and the Flight Telerobotic Servicer (FTS) program. Implementing the restructuring assessment recommendations has effectively removed all Work Package 3 projects from the Space Station Program.

Until work on the APAE project was halted in December 1990, significant progress had been made. For instance, the project had completed 95 percent of the redesign work resulting from the 1989 budget driven program redesign. This focussed mainly on changing APAE cooling from active to a simpler passive design. The project would have been conducting its PDR about now.

The FTS program also passed major milestones in fiscal year 1990. The most significant of these was completion of the Development Test Flight One (DTF-1) critical design review and the Phase 1 safety review. The project contractors also delivered a number of prototype subsystem hardware and components, e.g. actuators, flat cable, and circuit boards. Efforts to continue the FTS as a technology program will be continued under the management of the Office of Aeronautics , Exploration and Technology.

Work Package 4

Work Package 4 development activities take place at Lewis Research Center near Cleveland, Ohio. Work Package 4 and its prime contractor, Rocketdyne, along with the complementary supporting development contractors, are responsible for the Space Station's power systems.

In fiscal year 1990, Work Package 4 successfully completed tests demonstrating the ability to interrupt current levels at 160 volts DC, a higher voltage than achieved in any previous spacecraft. Additionally, initial tests were successfully conducted which demonstrated solar array control using the Sequential Shunt Unit and battery control using the Battery Charge/Discharge Unit. These were the first tests to demonstrate stability and control of the two units interconnected as they will be in the actual Space Station power system.

The Work Package 4 subcontractors began delivery of NiH_2 battery cells to the contractor responsible for battery development which will allow the beginning of the 25,000 cycle tests needed prior to launch. This will lead to building the first engineering model batteries Additionally, the solar array was validated in a test series equal to 10 years of in-orbit thermal cycles. Throughout the tests, performance remained constant and all cell to circuit interconnects were operational at completion.

International Partners' Activities

In addition to the progress I have outlined above in fiscal year 1990, NASA successfully completed an agreement with the international partners on the design of payload racks to allow rack interchangeability throughout all three laboratories. This agreement benefits the U.S. as well as each individual partner by allowing easy exchange and interoperability of research equipment. Each laboratory will provide standard interfaces, standard interface options and module specific interfaces for payload racks. The synergy of equipment use increases the efficiency of the entire Space Station manned base and significantly enhances overall program flexibility.

All of the international partners continued to move forward in their respective programs in 1990. The Japanese Experiment Module (JEM) design and development contract began in January 1990. The second of three JEM Program Requirements Reviews (PRR), on the safety and product assurance aspects of the program, was conducted in July. Japan also participated substantially in the ISPDR and restructuring assessment. Last month, the Japanese program conducted its third Program Requirements Review, covering operations and utilization requirements of the JEM. In December, the JEM preliminary design review will be conducted.

In 1990, the European Space Agency (ESA) received new proposals for its polar orbiting platform in October and the Attached Pressurized Module (APM) and

Man-Tended Free Flyer (MTFF) in November. ESA also conducted a PRR covering all aspects of its program in November and participated with NASA and the other partners in both the ISPDR and the restructuring assessment. The Europeans are presently engaged in a top level review of the industrial proposals. The preliminary design reviews for the APM and MTFF will occur in mid-to late-1992.

Canada completed the Mobile Servicing System interim PDR in August 1990, and also participated in the ISPDR and restructuring assessment late in the year. Their primary activity this year will be to continue detailed design of their elements and to focus on translating the results of restructuring assessment decisions into appropriate engineering specifications for their contractors. The next major milestone in the Canadian program is the Mobile Servicing Center critical design review in early 1992.

Description of FY 92 Budget

Now, having outlined the program's recent accomplishments and current direction, I would like to cover our plans for 1992. In setting our milestones for the upcoming year and, indeed, the remainder of the program, we have relied on the funding guidance provided to us from Congress last year. The budget request for the Space Station Freedom Program represents a balanced, well thought out approach to achieving a manned orbiting laboratory for the United States within these guidelines. Any further reductions in this program's budget can come only through schedule slips.

The schedule for the current and next fiscal years includes significant hardware testing and development milestones. Many test articles are being or have been constructed. These test articles are used to evaluate the manufacturing process as well as the design integrity. Although in most cases they will not become actual flight elements, these test articles are very similar or identical in design to actual flight elements and represent the final development stage prior to construction of the flight elements. These events will lead to the next major phase of Space Station development, the Critical Design Review (CDR). The CDR process is intended to ensure the detailed design complies with the program requirements prior to committing to the manufacturing of flight hardware. The engineering drawings will be 90% completed and significant development testing will have been accomplished. Many system and project CDRs will be initiated as we progress nearer to the initial construction of flight elements. Specific activities to be accomplished during fiscal 1992 are highlighted below.

Work Package 1

In fiscal year 1992, Work Package 1 will begin CDRs for a number of system and subsystem assemblies including the system racks, mechanisms and structures; restraints and mobility aids; tanks and plumbing for cryo carriers; the trace

contaminant control system; and the maintenance work station. Primary efforts will be directed toward the restructured program final design activities and development testing required for the distributed systems hardware, the resource nodes, and the U.S. laboratory. The unpressurized logistics element preliminary design will be completed along with its accompanying preliminary design review. Following this, the final design work will be initiated.

Pre-development testing will continue for the operational systems test for the ECLSS subsystems which make up the atmosphere revitalization system and the avionics air and fire detection and suppression systems. These subsystems will be operated together to determine the system interactions and to develop the subsystem performance characteristics. The temperature and humidity control test facility will be used to simulate cabin air flow in the shortened modules and with the international rack designs.

Development testing and evaluation will be continued for the internal audio system, structures and mechanisms, the composite rack, and the gas conditioning pallet oxygen and nitrogen systems. Requirements will be developed for qualification tests planned for the unpressurized logistics carrier structural test article, the gas conditioning pallet structure, and the U.S. laboratory Element Test Article (ETA).

The thermal control system hardware will be delivered to the contractor and brassboard hardware will be fabricated to conduct its development testing. Welding for the node structural test article and the module structural test article will be initiated. Operations Utilization Capability Development (OUCD) activities will include an integrated operations Program Requirements Review (PRR), mission planning system PRR, payload training complex PRR, payload operations integration center PDR, payload operations integration center system software PDR, and a mission planning systems requirements review.

Work Package 2

The single largest change resulting from the restructuring assessment affecting Work Package 2 is the change from an erectable to a preintegrated truss. Development activities will focus on detailed design and fabrication of the preintegrated truss segment test articles including the alpha rotary joint for the solar panels, the thermal radiator rotary joint, unpressurized logistics carrier attachments, the preintegrated truss structure, propulsion module attachments, antenna support and masts, and module to truss structure attachments. We also plan to fabricate the utility distribution system mock-ups with the preintegrated truss. We will begin procurement of utility distribution system components and development of the hardware.

The mobile transporter will be well into detail design in fiscal 1992. Fabrication and assembly of the mobile transporter, unpressurized berthing adaptor and transporter

energy storage system development hardware will be initiated. Detail designs are underway and will continue for node 2, node 1 common equipment, Pressurized Docking Mast (PDM) 1, and cupola 1 in preparation for the CDR. We will also begin detail design for node 1 unique equipment and the PDM 2.

Work Package 2 will purchase all raw materials for the manufacturing of the airlock in fiscal year 1992. We will complete the 1 g evaluations with the preliminary airlock mockup and will complete fabrication of the detailed airlock mockup for final crew integration verification. All technical drawings will be completed in preparation for the airlock CDR. The airlock hatch seal design testing will also be completed. We will finish the fabrication of parts for the airlock welding procedures verification article and will begin fabrication of the structural test article.

Detailed design activities will also continue on the thermal control system and fabrication of development hardware for several subsystems will be initiated.

In software development for fiscal year 1992, we will receive delivery of the second release of the data management system software for the standard data processor. This release will include most requirement functions and will be used extensively for testing by system developers. We also expect delivery of the flight version of the system software for the multiplexer/demultiplexer portion of the data management system, along with delivery of the first multiplexer/demultiplexer flight equivalent unit.

Work Package 4

Work package 4 hardware design and development activities on the power system will continue at a steady pace. Development of the solar arrays will continue and energy storage assembly qualification cells and battery charge/discharge units will be fabricated and tested. We will continue detailed design and testing of the beta rotary joints and electrical equipment assemblies. The development and testing of the breadboard and engineering model components will also continue. End-to-end testing of power management and distribution components will extend through fiscal year 1992. An engineering module hardware build-up will begin in preparation for the electrical system integrated test scheduled to begin in early 1993.

Supporting development activities complement those being performed by the prime contractor and include the independent verification of the prime systems engineering and integration efforts.

Kennedy Space Center

Although all activities at Kennedy Space Center (KSC) will be making schedule and content adjustments from the restructuring assessment, the general emphasis of Space Station development activities at KSC in fiscal year 1992 will be to initiate

construction of the Space Station Processing Facility (SSPF) and continue development of the Test Control and Monitoring System (TCMS). The TCMS is a joint development with the Space Shuttle that will replace the existing Shuttle launch processing system, which is rapidly becoming obsolete, while developing a new capability to process Space Station hardware. The SSPF CDR will be completed in 1992 and ground breaking was held last month for the SSPF structure. Construction on the SSPF will continue in 1992 through 1993. KSC will complete the design work on its share of the ground support equipment for the SSPF. KSC will also complete the project CDR for the TCMS in fiscal 1992 and development will continue at a rapid pace throughout 1992.

In response to concerns expressed by both the Augustine Committee and several congressional subcommittees, in 1992 we will also continue assessing options for using unmanned expendable launch vehicles to complement the Space Shuttle in delivering material to the Station. Our studies will include both existing unmanned systems and the planned new launch system.

Summary

The Space Station Freedom Program has made significant progress through a difficult stage in its development. Over the past year, our design review process has brought up a number of issues which required evaluation and action. We have made substantial progress and overcome these challenges. In some ways, the program now rests on a firmer foundation. We have proposed a simpler, smaller Space Station focused clearly on supporting materials processing and life sciences as directed by the Congress. The Station's inherent capabilities will allow it to support numerous other scientific and commercial users on a priority basis. However successful this restructuring assessment was, it was not completed without cost. This and past program reconfigurations resulting from budget reductions have adversely affected the morale and momentum of the teams working on the program. It is more important now than ever that this program receives the support of the Congress to avoid any further delay in its implementation. The Space Station is crucial to our nation for numerous reasons previously cited. I don't believe that the program can withstand another major budget reduction.

Mr. Chairman, we look forward to your continued leadership in the coming year. I will now be happy to respond to any questions you or the other Committee members may have.

Thank you.

NASA
National Aeronautics and Space Administration

FREEDOM

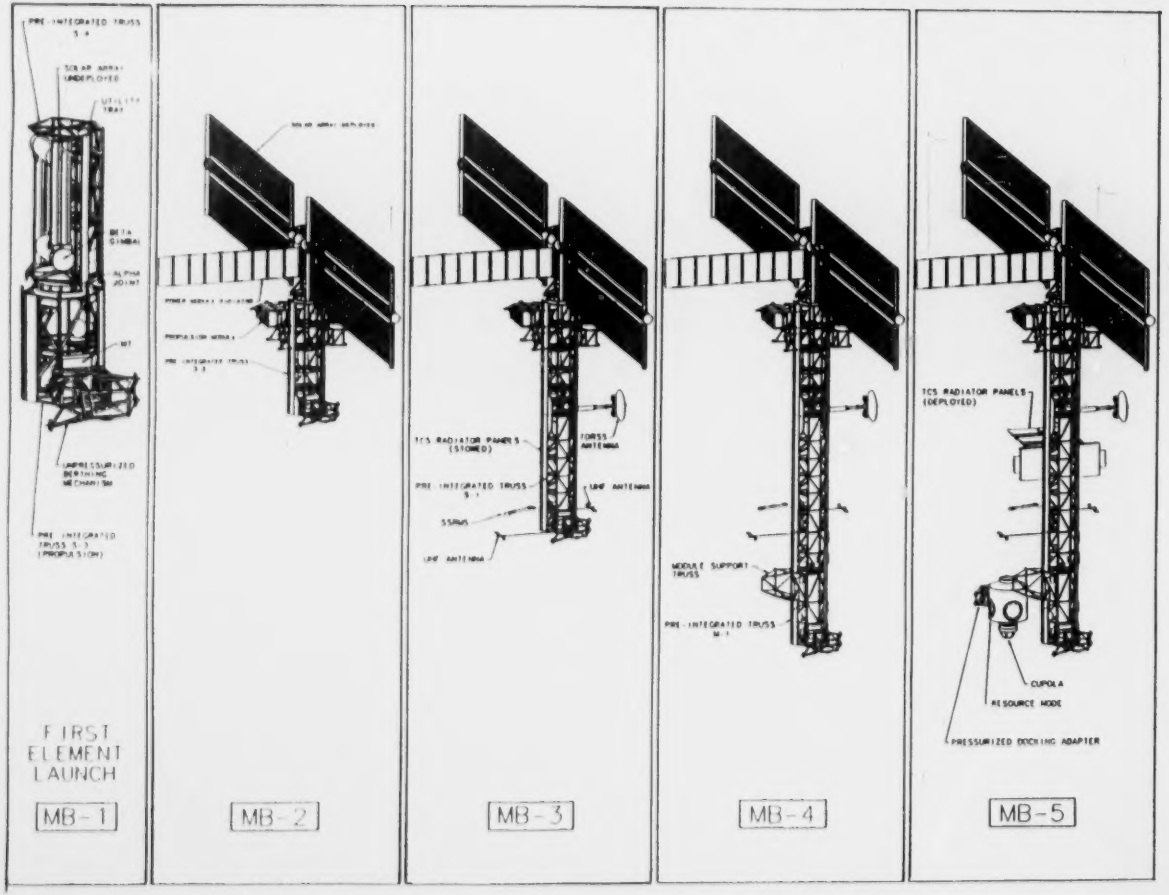
SPACE STATION FREEDOM
RESTRUCTURE
STATUS

525

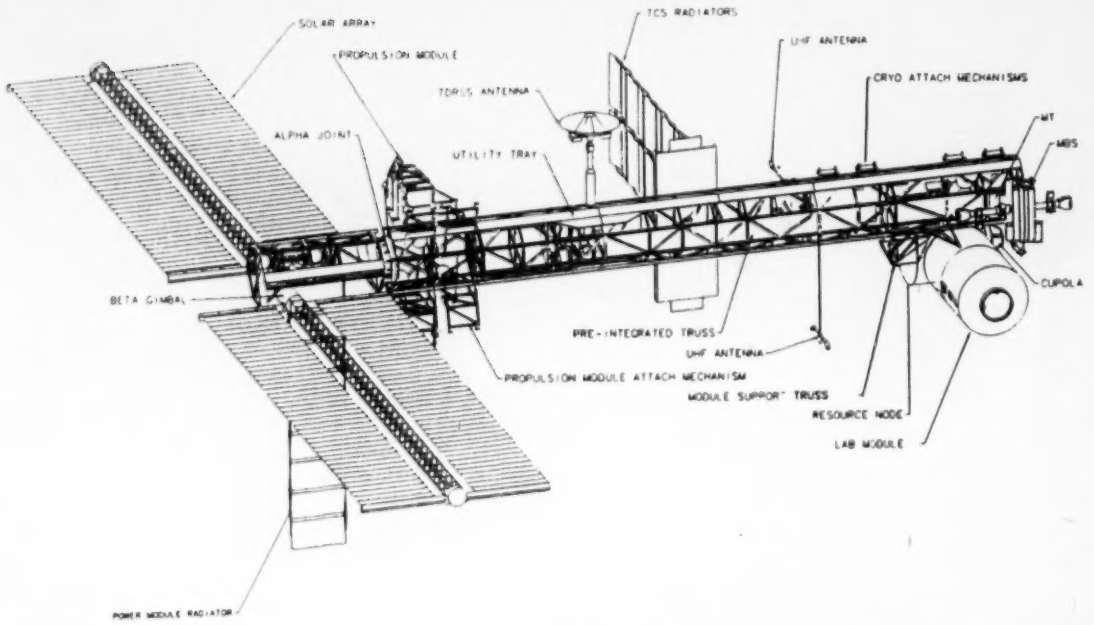
APRIL 11, 1991

RESTRUCTURED CONFIGURATION

Space Station Freedom



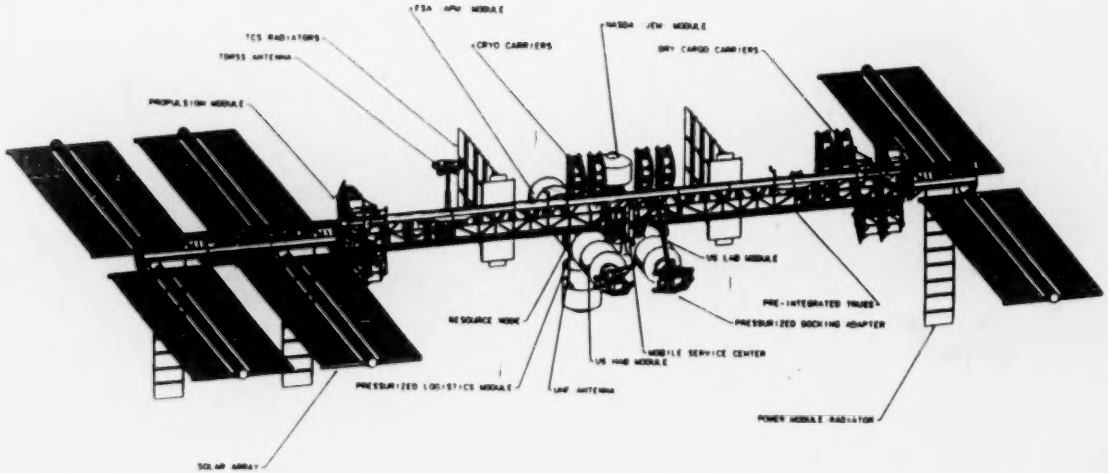
Space Station Freedom



MB-6

MAN TENDED CAPABILITY

Space Station Freedom

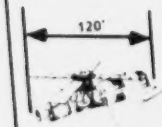
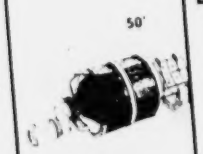
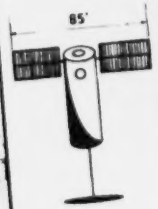
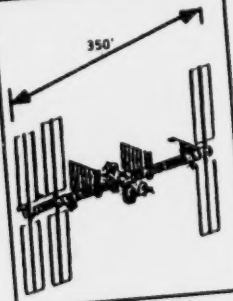


MB-17

PERMANENTLY MANNED CAPABILITY

SPACE STATION FREEDOM RESTRUCTURE

COMPARISON TO OTHER MANNED PROGRAMS

MANNED OPTIONS						
RESOURCES	Skylab	SPACELAB (STS)	CDSF (ISF)	Mid-90s MIR	Restructured SSF	
					MTC	PMC
Pressurized Elements	4	1	1	6	2	6
Interior Volume, $10^3 ft^3$	11.3	2.5	2.5	15	6	23
Power, kW	7.5	7	8.5	19	19	56
Utilization/Logistics Flights Per Year	3	0	3	15	3	4
Crew Time, 10^3 mh/yr	5.3	2.8	0.4	7.5	3	10
Permanently Manned	Intermittent	Intermittent	No	Yes	No	Yes
International Partners	No	Yes	No	No	No	Yes

OSS-16311
4/10/91

NASA

NASA
National Aeronautics and Space Administration
Washington, D.C.
20546

Biographical Data

JAMES R. THOMPSON JR.
NASA Deputy Administrator

James R. (J.R.) Thompson Jr. became deputy administrator of NASA on July 6, 1989, following 33 months as head of the Marshall Space Flight Center, Huntsville, Ala. During that period, the multifaceted Marshall Center oversaw the redesign and testing of the Space Shuttle's critical solid rocket boosters. The success of that effort was a prerequisite to NASA's "return to flight" on Sept. 29, 1988, when the Space Shuttle Discovery was launched on the first Shuttle mission in almost 3 years.

Before becoming Marshall director on Sept. 29, 1986, Thompson served 3 years as deputy director for technical operations at Princeton University's Plasma Physics Laboratory, Princeton, N.J. From March to June 1986, he served as the vice chairman of the NASA task force inquiring into the cause of the Space Shuttle Challenger accident. In that capacity, he headed the day-to-day operations of the 51-L Data and Design Analysis Task Force, which collected and analyzed information in support of the Presidential Commission on the Space Shuttle Challenger Accident.

Previously, Thompson spent 20 years with NASA at Marshall in various positions, including associate director for engineering in the Science and Engineering Directorate and manager of the Space Shuttle Main Engine Project in the Shuttle Projects Office.

Thompson joined the research and development team at the Marshall Center in 1963 as a liquid propulsion system engineer responsible for component design and performance analysis associated with the J-2 engine system on the Saturn Launch Vehicle. In 1966, he joined the Space Engine Section in the former Propulsion and Vehicle Engineering Laboratory and became chief of the section in 1968. In that capacity, he was responsible for the design and test evaluation of auxiliary space engine propulsion systems for the Saturn Launch Vehicle and experimental small interplanetary propulsion systems.

In 1969, Thompson transferred to the former Astronautics Laboratory where he served as chief of the Man/Systems Integration Branch from 1969 to 1974. In September 1974, he was named manager of the Main Engine Projects Office. In that position, he was responsible for the development and operation of the most advanced liquid propulsion rocket engine ever developed. He served in that capacity almost from the beginning of early development testing on the Shuttle main engine through the initial Shuttle flights.

- more -

NASA
National Aeronautics and Space Administration

Washington, D.C
20546

Biographical Data

WILLIAM B. LENOIR (Ph.D.)
Associate Administrator
Office of Space Flight

Dr. William B. Lenoir is the Associate Administrator for the Office of Space Flight. As the Associate Administrator for Space Flight, Dr. Lenoir has total responsibility for the development, procurement, and operation of the Space Shuttle; Space Station; upper stages for the Shuttle; management of all U.S. government civil launch capabilities; Spacelab (U.S.) operation; and the planning for future space flight, space transportation, and space system engineering programs. Dr. Lenoir is also responsible for developing and implementing the necessary policy for all Space Shuttle System, Space Station, and U.S. government civil launch activities. Dr. Lenoir exercises institutional management authority over the Johnson Space Center, the Kennedy Space Center, the Marshall Space Flight Center, and the John C. Stennis Space Center.

Dr. Lenoir was vice president and a member of the board of directors of Booz, Allen & Hamilton Inc., Bethesda, MD, and also managed that company's Space Systems Division until his current appointment. He directed the Booz, Allen role in program support for Space Station, including responsibility for space operations integration, technical and management information systems support and systems engineering and integration for the Space Station assembly process. He also managed several major Booz, Allen efforts in systems engineering, systems analysis, economic/cost analysis, system integration and program support.

Prior to joining Booz, Allen, Dr. Lenoir was the chief of the mission development group in the Astronaut Office at NASA's Johnson Space Center, Houston. He directed and managed all astronaut activities concerned with mission development and payload operations. He was responsible for the end-to-end integration and flight operations associated with satellite deployments from the Shuttle, satellite retrievals and repairs, Spacelab missions, extra-vehicular activities, mid-deck experiments, cargo bay experiments and development of future capabilities.

- more-

Dr. Lenoir flew in space as a mission specialist on Shuttle Mission STS-5, the first operational flight of the Space Transportation System, in November 1982 and served as the first spaceborne launch director to deploy the first communications satellite from the Shuttle.

Dr. Lenoir was born in Miami, Florida on March 14, 1939. He received a B.S. in 1961, a M.S. in 1962 and Ph.D. in 1965 in Electrical Engineering from the Massachusetts Institute of Technology. He received a Ford Foundation post-doctoral fellowship at M.I.T. and served 2 years on the faculty as an assistant professor of electrical engineering.

# # # # #

December 1989

DR. LENNARD A. FISK

Lennard A. Fisk is the Associate Administrator for Space Science and Applications of the National Aeronautics and Space Administration. He is responsible for the planning and direction of all NASA programs concerned with space science and applications and for institutional management of the Goddard Space Flight Center in Greenbelt, Maryland and the Jet Propulsion Laboratory in Pasadena, California.

Prior to becoming Associate Administrator, Dr. Fisk served as Vice President for Research and Financial Affairs at the University of New Hampshire. In this position, he was responsible for the administration of University research activities and was the chief financial officer of the University. Dr. Fisk joined the University of New Hampshire in 1977 as an Associate Professor of Physics. He founded the Solar-Terrestrial Theory Group in 1980 and was promoted to Professor of Physics in 1981. He was an astrophysicist at the NASA Goddard Space Flight Center from 1971 to 1977, and a National Academy of Sciences Postdoctoral Research Fellow at Goddard from 1969 to 1971.

Dr. Fisk is the author of more than 80 publications on energetic particle phenomena in space plasmas, and is a Fellow of the American Geophysical Union. He has served on numerous science and applications advisory committees.

He is a graduate of Cornell University. In 1969, he received his doctorate degree in applied physics from the University of California, San Diego.

Dr. Fisk is married to Patricia Leuba Fisk, and they have three sons.

Biographical Data

NASA Headquarters
Washington, DC 20546

NASA
National Aeronautics and
Space Admininstration

RICHARD H. KOHRS
Director
Space Station Freedom

Richard H. Kohrs was appointed Director, Space Station Freedom on June 1, 1989, with the responsibility for the design, development and future operations of the space station.

As Director, Space Station Freedom -- a program within the Office of Space Flight -- Mr. Kohrs is responsible for the activities required to develop a permanently manned space station, planned to begin initial orbital activities in the late 1990's.

Mr. Kohrs began his NASA career in 1963 at the Manned Spacecraft Center (now the Johnson Space Center), Apollo Spacecraft Program Office. In 1973, he moved to the Space Shuttle Program Office and served at various management levels.

From 1980 to 1983, Mr. Kohrs was Manager, Systems Integration, Space Shuttle Program Office. From 1983 to 1987, he served as Deputy Manager, and in 1987 he became Deputy Director, National Space Transportation System (Program), a position he held until being named Director, Space Station Freedom.

Prior to joining NASA, Mr. Kohrs was a stress engineer and operations analyst with the McDonnell Aircraft Corporation.

Mr. Kohrs' honors include the MSC Superior Achievement Award, the NASA Exceptional Medal, and the JSC Outstanding Leadership Medal. Twice he has received the American Institute of Aeronautics and Astronautics Space Systems Award.

Mr. Kohrs was born in St. Charles, Missouri, on August 25, 1934. He received his B.S. in mechanical engineering from Washington University, St. Louis, Mo., in 1956.

He is married to the former Charlotte Kelley. They have four children.

August 1990

ROBERT W. MOORHEAD
DEPUTY DIRECTOR
SPACE STATION FREEDOM PROGRAM & OPERATIONS
RESTON, VIRGINIA

EXPERIENCE

October, 1989 - Present Deputy Director Program & Operations, NASA Space Station Freedom Program Office

Responsible for the day-to-day management of the Space Station Freedom Program. Primary responsibilities include directing and controlling the technical content, budget, and schedule of the development portion of Space Station Freedom (design, development, test, production, and operation of the Space Station); ensuring the integration of all program elements including the international partners and user community into a single operational system; and establishing and controlling systems requirements and configuration.

May 1989 - October 1989 Special Assistant to Center Director for Programs

Identified management approaches and organizational structures to achieve strategic objectives of NASA and the Johnson Space Center.

September 1986-May 1989 Manager, Engineering Integration, NSTS

Reorganized NSTS Systems Engineering and Integration Office following the Challenger accident to achieve return to flight status.

February 1986-September 1986 Assistant Manager, NSTS

Chief investigator of the Challenger accident. Directed recovery of flight hardware and software; analyzed all system and subsystem flight performance and identified over 500 hardware and software improvements which were implemented before return to flight.

November 1985-February 1986 Deputy Manager, NSTS

Directed the transfer of sustaining engineering and logistics support of the space shuttle Orbiter from Johnson Space Center to Kennedy Space Center.

August 1985-November 1985 Deputy Manager, STS Orbiter and GFE Projects Office

Shared budget and technical performance responsibility for the space shuttle Orbiter and government-furnished equipment. Developed a viable logistics program for the Orbiter.

July 1981-August 1985 Manager, Avionics Systems Office

Project management responsibility for design, development and production of shuttle avionics. Expanded shuttle avionics to include autoland, nose wheel steering, head up display, Ku-band communications via the TDRS, improved on-orbit digital auto pilot, rendezvous capability and trans-Atlantic abort capability. Member of go/no-go launch decision team for 29 shuttle launches.

September 1975 - June 1981 Deputy Manager, Orbiter Avionics Office

Managed development and implementation of the shuttle avionics system. Managed hardware development, system test, and system integration activities. Designed, developed and produced more than 250 unique electronic Orbiter assemblies. Established test facilities used to integrate shuttle avionics and verify hardware/software compatibility. Directed integration and performance analyses to demonstrate compatibility of avionics systems in flight control, guidance, and navigation with shuttle program requirements.

March 1973-September 1975 Branch Manager, Avionics Systems Integration Branch

Developed system requirements for the shuttle avionics system. Lead government member of the technical team that established the shuttle avionics architecture which has exhibited exceptional performance for 30 shuttle flights.

December 1966-March 1973 Communications Systems Analysis Branch, Telecommunications

Developed communications system employed on the space shuttle Orbiter. Developed the communications systems architectures for the Apollo lunar communications relay unit, scientific data system, Apollo lunar surface experiments package, particles and fields subsatellite and lunar rover vehicle. Developed threshold extension devices that enhanced signal reception from the Apollo spacecrafts.

February 1964-December 1966 Technical Staff Member, NASA Communications Systems Analysis Branch

Performed systems analyses and engineering of the Apollo program's communication and tracking subsystems.

July 1961- February 1964 Technical Staff Member, Hughes Aircraft Company

Designed elements of ground based command and control assemblies for the Syncom communications satellite and the Surveyor lunar exploration spacecraft. Designed systems and procured hardware for airborne RF command, telemetry and tracking systems used in flight tests of Falcon and Phoenix missiles.

September 1960-June 1961 National Science Foundation Fellow, Mississippi State University

Designed and fabricated a double sideband and suppressed carrier amplitude modulation radio frequency signal detector.

EDUCATION

1963 Master of Science Degree in Electrical Engineering, University of Southern California

1961 Bachelor of Science Degree in Electrical Engineering, Mississippi State University; with honors

Graduate Study in Electrical Engineering, University of Houston

PROFESSIONAL AND HONORARY SOCIETIES

Alpha Phi Omega; Eta Kappa Nu; Tau Beta Pi; Institute of Electrical and Electronic Engineers (IEEE); IEEE Communications Society (National Director of Administration, 1979-1981)

SPECIAL HONORS AND AWARDS

Howard Hughes Master Fellow, University of Southern California; NASA Certificate of Commendation, November, 1972 and July, 1978; NASA Special Achievement Award, May, 1981; NASA Exceptional Service Medal, September, 1981; NASA Outstanding Leadership Award, 1988; Federal Senior Executive Service.

Dr. LENOIR. The only thing I would add is to emphasize the simplifications that we have made primarily in two areas. One is that we intend to build the trusswork and integrate it and check it out on the ground, assemble it in large pieces. Also we have shortened the modules, so that with the advanced solid rocket motors, they can be launched essentially fully outfitted, with as much equipment in it as we would have available at the time.

The other point I would like to emphasize is that we have brought several drawings and computer renditions here. The one on the right of the room is our permanently manned configuration, which is the beginning of the Space Station operation, not the end of the program. It is the beginning, the fruit of the investment we are requesting in order to provide that capability to form the basis of the decades of work and scientific endeavors that will be performed following that.

Mr. HALL. Dr. Fisk.

Dr. FISK. Thank you. I will make one brief comment and then answer your questions.

In response to your concerns on the science utilization of the station, we have worked closely with the committees that advise us and the Office of Space Science and Application and worked closely with the Space Station Office. I am very confident at the moment that both in the case of microgravity and life science that we can do world class research on this Space Station and fulfill the requirements that the Space Station has to conduct the science.

Mr. HALL. Mr. Kohrs.

Mr. KOHRS. The only thing I would add is that the program is proceeding. We have the NASA team, the contractor team, the international team, working every day of the week, led by Bob Moorehead. We are ready to continue our work and get on with bringing the Space Station forward.

Mr. HALL. Bob?

Mr. MOOREHEAD. Finally, let me say that we do have a design that I believe satisfies our requirements and it is buildable. Every element of this program is confident that we can deliver a station that we have designed in this restructured program.

Mr. THOMPSON. With that, Mr. Chairman, we would like to address your questions.

Mr. HALL. Thank you, Mr. Thompson. Mr. Bacchus, from Florida, who has an unusual and keen and abiding interest in this hearing and other hearings, I recognize you for an opening statement if you would like to make one at this time.

Mr. BACCHUS. Thank you, Mr. Chairman. I would simply like to say that I am a very, very strong supporter of the Space Station. I want to make certain we build the right station that can do the right thing and that we build it for the right price. Those are my principal concerns.

Moreover, I want to make certain that we build a station we can build on for the future. Thank you, Mr. Chairman.

Mr. HALL. Thank you. Mr. Rohrabacher, the gentleman from California, for an opening statement, if any.

Mr. ROHRABACHER. Thank you, Mr. Chairman. I appreciate your leadership that you have shown, and I am looking forward, in this session, to working with you on issues like the Space Station and

other projects dealing with space. If the United States is going to be the number one economic power in the world, I am convinced we have to be the number one leading power in space.

But in order to do that, Mr. Chairman, I am sure you agree with me that we have to be responsible and make sure that just because someone is up here and making some suggestions and has a good vision, that that does not mean we just roll over. I think there have been a lot of things going on with the Space Station that require a great deal of investigation on our part and a great number of questions have to be answered about costs and why there have been delays and why certain things we were told were going to work are not working.

If we are committed to a vibrant, vital space policy and space effort in the United States of America, I think we have to get serious. I think a lot of people have not been serious, and a lot of people have been playing games. I am anxious to take a look at the facts and talk with these gentleman and the other professionals in this area about them.

Thank you very much, Mr. Chairman.

Findings of Space Studies Board

Mr. Hall. Thank you.

With that, we will just kick off and get right into the part of that that will set us on the program we are on now, and change the program. I don't know about you men, but I was a little surprised by the Space Studies Board, although Lou Lanzarotti has always been a very respected and very objective leader in the field, I think I was surprised and I think other members of this committee were surprised.

I think even the Vice President was probably surprised at their findings and conclusions abruptly released right in the middle of the time when we were leading up to the funding of this station, and trying to determine—at that time none of us here really knew what the configuration was. I do not know to this time exactly what it is, but I am under the impression that we knew something about the restructuring of the station.

NASA has worked hard. To me the station was a crew of eight with full power of 75 kW and a crew of eight, and now we are down to 30 kW and a crew of four that they say can't do advanced life sciences. They have indicated by their report that no station was probably better than that as configured. I guess without trying to get you into a critical mood, were you surprised by the release of that report, or did you see it coming? Did you all have some input into it?

Mr. Thompson. Let me just make a general comment, Mr. Chairman, then ask Dr. Lennard Fisk, who has been working closely with that board, to respond. We have tried to keep Lou and the Space Studies Board apprised of the restructuring and the progress that has been made. Very clearly, some simplifications have been made and reductions in its size, I don't believe so much in its capability, to be consistent with the guidelines, the funding realities, that we have received from the Congress.

But yes, I think we were surprised. I was surprised at the position they take. We certainly do not share it, the President's Science Advisor also I think is very supportive of the program we are here with today.

But let me ask Len Fisk at this point to add anything he would like to add.

Dr. FISK. Thank you. I think what happened in this case is that the Board caught the restructuring process a bit in the middle, and then drew some conclusions on it. We have subsequently met with them and talked to them about what actually the station is capable of doing. I don't presume to tell you what position they would take now, but I think you would find that we really have no fundamental disagreements on what the station can do, and/or should be able to do.

You will recall in their report they said there must be a centrifuge. There is a centrifuge. We talked about the fact that there must be enough power to run life sciences, and we have assured them that there is, and provided documentation to that effect. So I think it would perhaps be interesting to talk to the Board and Lou Lanzarotti now, based on the fact that they have seen more details and have more understanding of what the station is capable of doing.

Mr. HALL. Do you—I guess you have respect and regard for the report, as far as it went, and it reflected their views. But it fell short of reflecting the additional needs for a Space Station, the Moon, Mars and other needs. Do you think there would be any benefit—and I don't like to spend money on studies, I think we study things to death up here—but do you see any merit in an independent engineering review of the restructuring plan with some input from you, recognition of the Space Studies Board? If that review could be done in a way that did not delay the space program, while the review is being completed, would that be of some benefit?

Mr. THOMPSON. I think we have certainly spent a lot of time on it. From NASA's standpoint, we are quite satisfied with where we are on the program today. If it would be of value to the Congress, then we would certainly support any other review process. As I look back, that has been a strength of our space program over the years. We have done it in other areas.

But we believe that based on where we are today, we have a very credible proposal, and I will leave it up to your judgment.

Mr. HALL. We have the Chairman of Science, Space and Technology here. Though I am normally required to turn to the minority leader, Chairman Brown may have time constraints that I am not aware of. Mr. Chairman, if so, we recognize you at this time.

ASRM

Mr. BROWN. Thank you very much, Mr. Chairman. I do have some constraints and I appreciate your recognition of that. But I will take a very small amount of time. Let me raise just one question. In the prepared statement is the sentence that "Our current planning is predicated upon the advanced solid rocket motor, because of the additional lift capacity" and so forth.

Let me ask you if the amount requested by the President's budget for the advanced solid rocket motor for this year is adequate to maintain the program on schedule to meet the requirements you have stated here?

Dr. LENOIR. It is probably not. As you know, we have an internal study going on at this time that we alluded to when we testified earlier to this subcommittee, that we should get the results on in the next two weeks or so, which is the mid-April date we had promised.

Our assessment is that it is probably short by $100 to $150 million in holding the schedule of a first launch for the advanced solid rocket motor in August of 1996. We would like to hold to that date so that we can earmark the second set of advanced solids for the launch of the laboratory module on this program. We have committed to that external date of the laboratory module in the second quarter of fiscal year 1997, although we are holding an internal date of December, 1996.

Mr. BROWN. I hope and trust you will be able to provide the committee with the detailed information shortly with regard to that. It is going to be an important element to our markup in the appropriations.

Mr. THOMPSON. Yes, Mr. Chairman, and we already have that commitment from the previous hearing.

NEW LAUNCH SYSTEM

Mr. BROWN. With regard to the proposed New Launch System, however, there is not the same criticality as far as it involves the Space Station assembly process or no criticality at all?

Mr. THOMPSON. We believe the program we have laid out and are discussing today is very launchable and maintainable with today's shuttle program. The New Launch System, or the national launch system we have been working on closely with the Department of Defense I believe is going to serve the Nation's needs at about the time frame of the turn of the century. That happens to coincide with the time we would be fully operating the Space Station and I think it would be a tremendous boost to augmenting the shuttle's capability.

Mr. BROWN. Thank you. I am sure some of the other questions I wanted to raise will be asked by other members of the committee, and I will not take further time. I appreciate your responses to my questions.

Mr. HALL. Thank you, Mr. Chairman.

Mr. Sensenbrenner.

BUDGET CUTS AND RESERVE LEVELS

Mr. SENSENBRENNER. Thank you very much, Mr. Chairman. In October of 1989, NASA wrote the committee in response to a question, a letter that said in part "For a large technical development program, historical data indicates a reserve level on the order of 25 to 30 percent is required, and that for the Space Station Program a reserve level of about 35 percent of the total cost is appropriate." The figures that have been submitted on the restructured Space Station indicate that the reserve has been cut to 10 or 15 percent,

which is a level two or three times lower than NASA stated was required a year and a half ago.

Why did you do that?

Dr. LENOIR. The reserve levels that we have were driven by two requirements. One is the requirement that you talk about, and that is that our sense of how much flexibility we will need as the program goes on, and the other is the availability of funds. We feel the reserves we have requested are the minimum, the absolute minimum, that would make sense in this program. They begin at 10 percent and grow, if I am not mistaken, to 20 percent as we get past the next couple of years.

The runout of our budget actually has a wedge that it has more money in it than just that. But if I look within the development monies we have identified, beyond the first couple of years we have a request of 20 percent for reserves. We feel that is adequate, but just barely adequate.

Mr. SENSENBRENNER. How much of the $2 billion reduction in funding of the program was achieved by reducing the reserve requirement?

Dr. LENOIR. I am not sure I can answer that quickly. We would have to do some analysis, since another year has happened, the happening of the year would spend some reserve. Every year, when out years get one year closer, you commit some of that reserve to now known requirements. I am not able right now to take that out and say the difference is what we actually spent.

Mr. SENSENBRENNER. Let me ask the reverse of the question then. How much additional money do you need to bring the reserves up to the 25 to 30 percent you stated was absolutely necessary a year and a half ago?

Dr. LENOIR. Approximately 10 percent.

Mr. SENSENBRENNER. And that is how many dollars?

Dr. LENOIR. Approximately $200 million.

Mr. THOMPSON. Congressman, I don't want to leave the impression that we don't believe we have adequate reserves in this restructured program. I believe we do. Here we are a year and a half smarter, we have been through the design reviews that have taken place, the simplifications in this Space Station relative to taking off some of the robotic capability, I think it makes this very much a doable program with today's technology and reduces some of those stringent requirements. I think NASA is very comfortable with where we stand now. We have certainly got a big job to do, but the reserves we have planned in this program make it credible.

Mr. SENSENBRENNER. Mr. Thompson, I am afraid NASA is backing itself into a corner where several years from now it is going to get trashed by some investigative T.V. reporter for huge cost overruns. One of the things the reserve requirements historically have done is to provide a cushion in case there are cost overruns, some of which are controllable and others of which are not.

If the cutting back on the reserve requirements from 35 percent which was specifically stated as necessary for the Space Station to 10 or 15 percent—I can just see the 60 Minutes and 20/20 Programs coming on three or four years from now about the Space Station, being very similar to their exposes of $600 toilet seats being procured by the Defense Department.

I think what you are doing here is attempting to appease the Appropriations Committee on a short-term basis and you are going to end up sowing the seeds of destruction several years from now in the Space Station Program after we spend a few billion dollars more. I would strongly urge you to rethink that with more of a long-range view.

Mr. THOMPSON. I can certainly appreciate your concern and your point. We worked this problem within the affordability guidelines of the Congress, but we picked the launch date. We took the time after the program team had gone through the review process. Dick Truly set in motion an independent cost exercise within NASA. We included OMB in that. If we thought that the program the President had submitted to this Congress was inadequate to do the job, then that would have been reflected in the launch dates, or we would have deferred it further.

Again, I certainly appreciate your concern and that is right on our hit parade, too. But I believe we have a credible program now, and that we can do it for the money we have asked for.

Mr. SENSENBRENNER. Well, perhaps there is a short in my Japanese calculator, as I am adding up the costs on this. But it seems to me that every time we defer launch dates, we push back programs, we come up with a new and stretched out schedule, we are adding to the total cost of the project by the time it is done and permanently manned and the construction phase is over with. The reason I say that is that there is a certain fixed overhead that occurs every day that the project is going on. If we can get the project done quickly, the fixed overhead is less and thus the total cost is less. If the project drags on three or four years behind the original target date, that fixed cost is a heck of a lot more money.

I am familiar with the construction industry a little bit. The homebuilders that go bankrupt are the ones that can't get their houses done on time and get them sold and get their construction loans paid off so that the interest meter stops ticking. We don't have those kinds of fiscal requirements dealing with Government projects, but I think the same is true in terms of what a total cost overrun would be when you compare the original proposal on how much it would cost when it was originally approved and what the total is at the time the thing is completed.

Again, I see a trap being set, and NASA and a lot of other people going like the lemmings off the cliff. Very frankly, I am very uncomfortable with it.

Mr. THOMPSON. Well, again, I certainly appreciate your point. I think the biggest trap that may be in front of us is that the program we have laid out will not meet the funding requirements as we go in the outyears. I think that's what we have to try to avoid. We believe we can execute this program for what we are presenting to the Congress today.

But in three years, we cannot repeat the history of the last three and come up short in the funding. Otherwise, we will get in this stretched out mode and increase the overruns.

Mr. SENSENBRENNER. Mr. Thompson, if the Budget Committee and the Appropriations Committee end up taking another big whack out of the outyear funding as they have done in the past, once the appropriation process is completed in the Fall of this year,

and if that happens, and I hope it does not happen, will you come up here and say we ought to zero out Space Station Freedom because we can't build the station at the reduced amount?

Mr. THOMPSON. If we continue along the path we have of selling the program short on an annual basis, then I think collectively we ought to rethink what we are trying to do. We could add the 30 or 40 percent contingency, and if we fall back into that trap, then yes, we have troubles in the future.

Mr. SENSENBRENNER. I don't mean to put words in your mouth, but I guess you answered my question yes.

Thank you very much. I yield back.

Mr. HALL. The Chair recognizes Mr. Zimmer.

Mr. ZIMMER. Thank you very much. I would like to clarify the point about the Space Studies Board. Your testimony is to the effect that the Space Studies Board is now satisfied with the current restructuring of the Space Station; is that correct?

Dr. FISK. I don't think it should be my statement whether they are satisfied or not. I think you ought to ask them. But let me state we have met with them and they had a number of issues concerning the location of the centrifuge, the power, how the equipment would be distributed, and so forth. In my judgment, based on that meeting, we satisfied the issues they had. But you really should ask them.

Mr. ZIMMER. We should contact them. We have to vote today on the authorization.

But it is your expectation that they will be issuing a revised report with a different conclusion?

Dr. FISK. I am sorry. I have no idea.

Mr. ZIMMER. On the point of the centrifuge, it is my understanding that might have been an add-on, that the centrifuge node may in fact have been an add-on in response to the Space Studies Board report. Is that accurate?

Dr. FISK. I think this is a somewhat fluid situation. Let me just review how this went.

Prior to the restructuring of the station, there were four nodes on the station. One of them was going to house a 2.5-meter centrifuge. When the restructuring occurred, a number of nodes went down the tubes. There was no node available for a 2.5-meter centrifuge.

We then gave very serious examination to flying a 1.8-meter rack-mounted centrifuge in one of the laboratories, probably in the Japanese one, just because of the availability of the type of plumbing in the laboratory. That we gave serious consideration, but have now determined it will be possible to have a third node on the flight immediately following the permanently manned. Given the availability of that node, we revert to the original solution on this, which was a 2.5-meter centrifuge in that node.

That is clearly the preferred solution, because with a 2.5-meter centrifuge you get variable gravity, larger numbers of sample sizes; you meet all the requirements. The 1.8-meter centrifuge does satisfy the need for being able to provide a control, which is what you want a centrifuge for, but it is obviously not as capable as the 2.5-meter one.

So I think everybody is satisfied with the solution that has been found, and the timing on it is such that it did occur recently. One thing you ought to always remember is that there has always been a centrifuge in this program. We have never contemplated flying the Space Station without a centrifuge, because you can't do life science research without it. The only issue is what the size would be.

Mr. ZIMMER. I am new on this committee, as you know. And 2.5 meters was as large as it was ever planned to be?

Dr. FISK. That's correct.

Mr. ZIMMER. Would it be possible that the node would be slipped to a follow-on stage after permanent manned capability?

Dr. FISK. The current plans are that it is the flight immediately following PMC. I have no reason to think that won't occur.

Mr. ZIMMER. Has this showed up in the anticipated budget, the $30 billion price tag for the Space Station?

Dr. FISK. There are two answers to that question. Let me give you one. The centrifuge costs are always in the budget of the Office of Space, Science and Application. That's where they are kept and they have been there for a while. Funding profiles are adjusted to when the delivery schedule will occur.

The cost for the node I will defer to Dr. Lenoir.

Dr. LENOIR. In achieving the integration of the centrifuge the cost of the node and the integration of the centrifuge into the node is a much smaller cost than the cost of developing the centrifuge itself. So within the Space Station budget, the moneys to accommodate the node and integrate the centrifuge into it are small and while they are not specifically a part of what we call the permanently manned configuration development, since this is for the very next flight, the funds are available in what we call the wedge. As the development funds for permanently manned capabilities begin to decrease, then the available funds, if they hold steady, would afford a follow-on phase, of which this would be the first flight.

Mr. ZIMMER. So as I understand it, that is not included in the $30 billion price tag? It is for a phase that—in the category of expenditure that follows the $30 billion expenditure?

Dr. LENOIR. Strictly speaking, I would have to say yes, that's true. The number we are talking about is so small that it would in fact fit in there.

Mr. ZIMMER. How small is that number?

Dr. LENOIR. It is $30 million to $40 million.

Mr. ZIMMER. Thank you. I am concerned about the fact that as the Augustine Commission reported, that in the early phases of construction and even operation, you are going to be relying solely on the shuttle for construction and maintenance transportation. Given the history of shuttle reliability and frequency of flights, can you give us some comfort that we won't either slip in the timetable of construction or we won't be left with a Space Station that can't properly be tended?

Dr. LENOIR. In the early phases of the assembly, we planned four assembly flights each year. In supporting the station, that is all that is required until we begin to utilize it after we have achieved man-tended capability. That is four flights per year out of a shuttle

schedule that is allocating 10 flights in each of those years. The Space Station, of course, will be one of our very highest priorities and have first call on the space shuttle flights. We are quite confident that four flights a year will be available for the Space Station.

The other side of that coin is that if for some reason, whatever the reason, that we did not achieve that schedule in assembling the Space Station, at each and every step along the way the Space Station is able to survive for at least a couple of years. It is a variable, depending on exactly when this occurs and what actions we take. But it is able to survive on its own for at least two years, frequently as much as three years. That provides us another degree of confidence that we are not doing anything dumb.

Mr. ZIMMER. As you know, the Augustine Commission points to the high level of possibility that there would be another catastrophic failure of the space shuttle, which could in fact lead to a prolonged period of the Space Station being unreachable. Physically, you say the Space Station will not be harmed.

However, I think the public support for the Space Station and by extension the space program, would be inestimably harmed, because we are putting a lot of our eggs in this basket. This is considered to be the program that will provide the capability for Lunar and Mars missions.

Could you please comment on the problems that would come from the fact of having this multi-billion dollar piece of hardware in orbit?

Dr. LENOIR. Yes, sir, we certainly agree with the importance of the Space Station and it being the trailblazer of the future in the Nation's space program. However, we are confident that the space shuttle will provide adequate support. In the space shuttle side of NASA we have a much better risk analysis, risk assessment and risk management program than we had prior to the Challenger accident.

I would not envision that if we had a catastrophic failure like Challenger that we would be inoperable for as long as we were then. I believe we have a better system for understanding what our problems are, fixing them more quickly, assessing the acceptability of risk and getting back to a flight status very quickly.

Being down for their fleet grounded is always a bad situation, not only for the Space Station, but for the space shuttle program and the entire Nation's space program.

Mr. ZIMMER. Let's say we have less than a total shutdown of our capability and we have only one orbiter out of service. Who gets bumped? Would it be the mission to fix the Hubble Observatory, or the station, or what would your priorities be at that point?

Dr. LENOIR. I can't definitively answer that at this time. As you know, the schedule is somewhat flexible. It changes from years to year. We would have to look at when it happened, what our available resources are, is it three orbiters instead of four? Where are we with respect to our maintenance inspection periods, because if I have no orbiters in the structural inspection period, I can sustain ten flights a year with only three. If I put one into a structural inspection period, then I probably can't sustain ten flights. We would have to look at our strategy—do we bump somebody, do we stretch out a schedule? But in no regard would we ever consider allowing

the Space Station to get into trouble because we did not go continuous assembly, or its operation.

Mr. ZIMMER. So in that circumstance a lot of other high priority programs would take second priority to the station?

Dr. LENOIR. We would have to evaluate the requirements at that time, and prioritize them and behave accordingly.

Mr. ZIMMER. You have indicated that the restructured program is more resilient than the previously baselined one. Yet you are now dependent on the existence of a new launcher to launch 5 of the 17 assembly flights, and a number of the utilization flights, and of that new launchers not used, additional flights are going to be required. Could you explain the reasons for this change in the ground rules? Are you truly increasing your resiliency?

Dr. LENOIR. By the new launcher, I believe you are referring to the advanced solid rocket motors. We do not look up it as a new launcher so much as an upgrade to the basic space shuttle system. At the time we went into the restructure, we had the basic Space Station Program baselined with the use of our current solid rocket motors, but indicated that coming out of the preliminary design review, if the schedules remained compatible that we at that point intended to baseline the advanced solid rocket motors. That was independent of any restructure activity.

We primarily want to take advantage of the higher lift capability that the advanced solid rocket motors give us. The advanced solid rocket motors will allow the space shuttle to put 12,000 pounds more payload into orbit than the current solid rocket motors, and of that 12,000 we have allocated 8,000 to the Space Station payload on its flights. That 8,000 pounds makes the difference being able to essentially fully outfit, put the racks into the laboratory and have modules on the ground, integrate them, test them, check them out, and then launch them.

If we do not have the advanced solids available, it is not that the Space Station is a no-go situation, it is just that I would have to fly another logistics outfitting flight following the launch of the lab in order to bring the rest of the equipment, and then integrate and check it out on orbit.

Mr. ZIMMER. Thank you very much. I believe my time is up. But I am deeply concerned that this entire program, and by extension I believe the keystone of currently structured space programs, is hanging by a fairly slender thread. The transportation capabilities are very vulnerable, and with that I yield back.

Mr. HALL. Thank you. Just for the record, is it about $200 million for the development of the node and then $30–$40 million per node thereafter, just generally?

Mr. THOMPSON. Dick, will you help me with that question?

Mr. KOHRS. To add a node is roughly $20 million. Then when you add the structure you have to outfit it, which is the neighborhood of $10–$15 million. So when we say we are going to add a node to house a centrifuge, we are talking about a $30–$40 million cost to the Space Station Program.

Mr. HALL. You include integrating the life sciences facilities into it, and that's the $10–$15 million?

Mr. KOHRS. Yes.

Mr. HALL. Okay. I won't use any more of your time on that. The Chair recognizes Mr. Bacchus. I would urge you to keep your remarks and question as close to five minutes as you can, you are not relegated to five minutes, but you get a second and even a third shot at this folks if you want it.

FLIGHT TELEROBOTIC SERVICE

Mr. BACCHUS. Thank you, Mr. Chairman. I will try to be brief and to the point. I would like to discuss robotics. In this latest reconfiguration, among other things you are assuming that we will save money by eliminating the need for 50 percent of the previously required EVA, because we will have robotic maintenance. At the same time, we are saving money by eliminating the FTS, the Flight Telerobotic Servicer. We are continuing to rely, therefore, on the Canadian system that is being built for the robotics part of this joint venture.

I have several concerns in that regard. First of all, we have been planning to have a shuttle flight to test the FTS, after we developed that American robotics technology. That too has been eliminated since we are not going to be developing the FTS in its latest configuration. What plans are there to do any flight testing, any testing in zero gravity of the Canadian structure?

Dr. LENOIR. Let me back up for a minute. We have removed the requirement for and hence the Flight Telerobotic Servicer from the Space Station Program, but we have not totally walked away from it. We have transferred it to our technology branch, the Office of Aeronautics Exploration and Technology, where we will pursue it as a technology endeavor. We are currently planning to do a test flight probably very similar to what had been planned as the first test flight on the Space Station's Flight Telerobotic Servicer.

Mr. BACCHUS. When would that be?

Dr. LENOIR. That is under review right now, as to what our schedule is, exactly how the funding will support it and what the augmented and changed requirements will be. But it will probably be a year later than we had originally been planning.

Mr. BACCHUS. How would the proposed committee authorization affect what had been proposed by the President in his budget in this respect? Would it affect your plans at all?

Dr. LENOIR. I don't believe so.

Mr. THOMPSON. The President's budget—we had assumed that we would take the FTS system, convert it to a technology program with anticipation of having a prototype flight once we get the program restructured.

Mr. BACCHUS. Getting back to my previous question about the Canadian system——

Dr. LENOIR. Can I add to that? Apparently, in your markup yesterday you are deleting the FTS from the Office of Aeronautics, Exploration and Technology. That would eliminate that test flight.

Mr. BACCHUS. That's the source of my concern.

Getting back to my original question, what plans are there to do any test flight for the Canadian system, if any, or what plans are there to test it in zero gravity?

Dr. LENOIR. Our plans to test on zero gravity will begin on, I believe it is the third flight it is launched on, that will be to check it out and verify that it works, following very much the same procedure and techniques that we used to bring the space shuttle's remote manipulator system into operations, which was also built by Canada, by the same contracting team.

Mr. BACCHUS. If we are not going to have a test flight then——

Mr. HALL. Would you yield just a moment?

Mr. BACCHUS. Yes, sir.

Mr. HALL. Mr. Nagle, who has an unusual and keen interest in launching and recovering, has just advised me that Atlantis has just made a successful landing. I thought you all might like to know that.

Mr. BACCHUS. That is certainly good news.

If we are going to delete the FTS test flight, and if we are not going to test the Canadian system until we begin to use it, how much are we relying on that system and if it does not work, what will it do to our overall plans for the Space Station?

Dr. LENOIR. We test—the Canadian system comes in two parts. The arm itself, which is analogous to the space shuttle's manipulator arm, is what we launch on the third flight. We will use it in much the same way as we used the space shuttle's arm, only it will be from a station base instead of from the space shuttle's cargo bay base.

The equivalent of the Flight Telerobotic Servicer, what the Canadians call the Special Purpose Dexterous Manipulator, is coming up later. That is number six or seven? I believe that is on the seventh flight. In the interim, we will use the manipulator arm much the way we used the shuttle arm. We do not feel there are any technology issues we need to verify that have not been verified by flying the shuttle arm, and we are quite confident in that.

In that time frame and immediately after the seventh flight that launches the Special Purpose Dexterous Manipulator, we have no specific requirements that cannot be done any other way that would require that. I think what I need to emphasize is that in going into the restructure, and simplifying the design and simplifying the assembly operations we have removed the requirements for manipulation by suited crewmen and by robotic devices so that it has gotten much simpler.

We are confident that launching this Canadian Special Purpose Dexterous Manipulator on flight seven is adequate. We will test it out. In the unlikely event we should find we have a problem with it and it does not perform correctly, we could either repair it in orbit or bring it home for repair and continue to assemble the rest of the Space Station and go into operation.

Mr. BACCHUS. Looking at the longer term, what role do you see telerobotics playing in other missions, in manned missions other than the Space Station and unmanned missions, as well? What would the committee's proposed cuts in this area do to those plans?

Dr. LENOIR. From a Space Station or manned space mission, the robotic devices will be absolutely instrumental in on-orbit servicing. We need to understand that technology, we need to have a better technology base. As we look forward into exploration, first of the Moon and then of Mars, we must have a better technology base

to build our robotic explorers that will precede the man and augment the man. Having cut that, we will be slowing down the United States' endeavor to come up to speed in the technologies of those robotic devices.

Mr. BACCHUS. So you would prefer that we not cut those?

Mr. THOMPSON. You bet. [Laughter.]

Mr. BACCHUS. Thank you. Thank you, Mr. Chairman.

Mr. HALL. The Chair recognizes Mr. Rohrabacher, the gentleman from California.

ESTIMATED COST OF SPACE STATION

Mr. ROHRABACHER. Thank you, Mr. Chairman. You will excuse me for asking some fundamental questions here, and also I am a layman in that I am not a scientist. Sometimes I don't understand some of the more complicated engineering questions that have been asked. Even more often, I don't understand the answers to those questions.

Mr. HALL. We will ask you to speak American to the gentleman from California.

Mr. ROHRABACHER. If we could start from the beginning, what was the original cost estimate, Dr. Lenoir, of the Space Station, the original estimate when we first approved it?

Dr. LENOIR. The original estimate for developing part of a Space Station—I believe you are trying to get me to use the number $8 billion.

Mr. ROHRABACHER. For some reason there is this figure in the back of my mind, somewhere in there, where somebody said it was only going to cost us $8 billion.

Dr. LENOIR. That is correct, that was for part of a Space Station and that was in 1984.

Mr. ROHRABACHER. So in 1984, and when it was approved, that $8 billion figure was not being used when we approved that?

Dr. LENOIR. That was for development only. That did not include any operations facilities, operations, or the logistics or utilization or transportation.

Mr. ROHRABACHER. Aha. So that $8 billion figure, which for some reason got into everybody's mind, was absolutely irrelevant.

Dr. LENOIR. No, it was the number at that time we felt required——

Mr. ROHRABACHER. But it did not include all those other things you just mentioned.

Dr. LENOIR. It was not complete, you are right. In looking at the follow through of the total program, it was not a good figure for us to be operating on. There were those of us who were thinking about it, and I was at the White House at the time, that $8 billion figure really was not a realistic figure. When Ronald Reagan was first presented with us, and he was presented with the idea it would be an $8 billion project, that was not an accurate cost estimate.

Mr. ROHRABACHER. What was the cost estimate before this current restructuring?

Dr. LENOIR. Before the current restructuring, the development costs equivalent to the $8 billion was a little over $12 billion.

Mr. ROHRABACHER. I am not asking that. I am asking, before the restructuring, how much we were considering it would cost for a Space Station, a complete project.

Dr. LENOIR. For a complete project, and remember that this project goes on essentially indefinitely——

Mr. ROHRABACHER. So I can't talk about operating expenses.

Dr. LENOIR. Let's talk about through 1999. Before the restructuring we felt the total project cost was $38.3 billion, and that did include almost $13 billion of operations. That was $16.5 billion for development, $12.8 billion for operations and $7 billion for shuttle and other transportation.

Mr. ROHRABACHER. And the current cost estimate is $30 billion?

Dr. LENOIR. That's correct.

Mr. ROHRABACHER. Does that include the cost of operation?

Dr. LENOIR. That is everything we could think of through the year 1999, that does include operations and transportation.

Mr. ROHRABACHER. How much has been spent to date on this project?

Dr. LENOIR. About $3.8 billion. That does not count this year. So add another billion. About $4.5 billion or thereabouts.

Mr. ROHRABACHER. We have spent $4-$5 billion on this project, and it seems to be going through massive changes in front of our eyes. With estimates and with engineering designs and with goals of what we are going to accomplish, who is to blame for this? Who should we say was not doing their job or did not do a good job in presenting the information we needed to make our decisions?

Dr. LENOIR. I don't know we can say any individual is to blame. Certainly for the last several years, two or three years, I don't believe we were ever in a situation where had the budget developed along the lines we had requested and planned for that we would not have been able to build it. We believe we could have built what we have proposed.

Mr. ROHRABACHER. So your answer then is that Congress should share a large percentage of the blame for this what seems to be—well, I won't call it a mess, but it seems to be major changes in cost and what seems to the public might be interpreted as a mess.

Mr. THOMPSON. Let me add to this. I think the blame, if you want to call it that, would rest with NASA in terms of initially laying out the cost of the program. We need to do a better job of that. And there have been a lot of add-ons to this program that in retrospect I think should have been stifled. Once we have got the program laid out and stabilized then Congress very clearly is a part of providing the stable funding. That is something I think mutually we need to work on in the future.

We believe we put the effort into laying out the total runout costs through the year 1999 of the $38.3 billion. We have broken it out into the development and operations phase. We know the content and are responding to the questions on that. Now we need to make sure we provide the annual funding so we don't stay in this loop of replanning and rephasing.

Mr. ROHRABACHER. To get back to the original question, now, what I have heard is that there was a lack of control in the beginning of people who had new things they wanted to add onto the Space Station, and that is one of the major causes for these

changes. The other factor is that Congress has not given you a basically stable funding level, and basically a commitment that was an unchanging commitment from our side.

Mr. THOMPSON. That has been a problem.

Mr. ROHRABACHER. How much was the cost for an operating Space Station before this reconfiguration and how much is it now, annual cost?

Dr. LENOIR. Help me, Dick, what was it before?

The current operating cost is estimated in 1999 to be about $2 billion. That is if you think in the permanently manned capability, that is the steady state then. In the report we sent to you, we broke that up into its various components.

As I recall, the number prior to that was in the $2.4–$2.5 billion range, so that the annual operating costs of the restructured program have been brought down approximately 20 percent.

Mr. ROHRABACHER. I see.

Are all the costs in terms of the $30 billion figure that we have now in front of us, and we are told that the $8 billion figure was not accurate because many of these other factors were not put into the equation, does the $30 billion figure include all the costs, or are we going to be coming back here listening to somebody say "Well, that didn't include these other things."

Dr. LENOIR. To the best of our knowledge, that includes from the facility development point of view everything with one exception and that is the assured crew return vehicle that we have not included in that number, because we are currently completing the development of the concepts, and we don't think we have the ability to provide real mature numbers. That is estimated to be another $1.5–$2 billion for development.

The other thing that is not in there, because internal to NASA we manage it differently, is the development and operations of the science side. That $30 billion develops and operates the scientific facility, but not the scientific experimentation.

Mr. ROHRABACHER. Will the $30 billion figure bring us to a point where we have a Space Station operating and—you use the word development—I guess what I am getting at is will that $30 billion figure carry us to a point where there is a Space Station in orbit and it is operating?

Dr. LENOIR. As soon as we get you the mature numbers on the assured crew return vehicle and add that to it, yes, it will.

Mr. ROHRABACHER. That also does not include the life sciences facility, is that correct?

Dr. LENOIR. For the parts of the life sciences facility that are provided by the science organization as opposed to the Space Station, that's correct.

PLANS FOR LIFE SCIENCES ON THE SPACE STATION

Mr. ROHRABACHER. What plans do we have at this point for life sciences and what are we talking about there?

Dr. FISK. The life sciences experimentation is, as Bill said, carried in the Office of Space, Science and Applications budget and it is our plan that at the point we reach permanently manned capability, plus one flight, we will have a series of facilities ranging

from gravitational biology to human physiology to controlled ecological life support systems, studies of exobiology, a total of about 13 or 14 individual double rack facilities, plus the centrifuge and its related facilities. Our budgets support the development of those and they will be taken up sequentially during the development phase and all be on board at PMC.

Mr. ROHRABACHER. What added costs are we talking about to the $30 billion figure in what you just described?

Dr. FISK. I will have to answer in detail for the record, but bear in mind that one of the reasons we often talk about having the science budget track the growth of the agency budget at 20 percent is that that then gives the science budget the resources necessary to develop these facilities. My guess is it is in the total science utilization of the station, both microgravity and life sciences, in the $1-$2 billion.

Mr. ROHRABACHER. So when you include the escape vehicle, which is not included in this $30 billion figure and perhaps the money that will be spent for life sciences, we are talking about another perhaps $4 billion or $5 billion?

Mr. THOMPSON. It is in the range of $4 billion.

Mr. ROHRABACHER. All right. I think I will leave it at that, Mr. Chairman.

Mr. HALL. I'm not going to ask what in the range of $4 million is. We will go to Mr. Nagle.

INTERNATIONAL PARTNERS' REACTIONS TO RESTRUCTURING

Mr. NAGLE. This is not a venture that we operate strictly by ourselves, obviously we have European partners, Canadian partners and Japanese partners. This has kind of been pushed to get back to us, and I am wondering what the consultations that have taken place with the other partners in the venture, whether they are on board for restructuring, or are those discussions ongoing? How do the Canadians feel about having their robotic arm dropped from program—those kinds of things? What is the status?

Dr. LENOIR. As we went through the restructuring exercise, our partners supported it, day to day, in our Reston facility. They were a part of it, they looked into things we were considering, they gave us their opinions, we listened, and having come through to the conclusion, they are not real happy with the schedule slips that are required, they understand that they are required.

They feel what we have done is the best we could do with what was available, and each partner has sent from the equivalent of Admiral Truly in their organizations to Admiral Truly a letter expressing support for the restructured Space Station Program, and an indication that they wish to proceed.

Mr. NAGLE. How do the Canadians—that's of particular concern to me, it seems they had a major portion of the project, and their project, if I understand it, has either been delayed, deferred or deleted. Am I wrong on that?

Dr. LENOIR. It's the United States' counterpart to what they had that has essentially been moved off the program. Let me just say that that does not make them unhappy.

Mr. NAGLE. What was that?

Dr. LENOIR. The Flight Telerobotics Servicer we spoke of earlier. But the Canadian Arm and the Special Purpose Dexterous Manipulator are still very much a part of the program. The Canadian space agency is happy and satisfied with the restructure and is proceeding with us.

Mr. NAGLE. Staff prepared a memo for us, of course, and I think one paragraph bears at least some focus. They wrote that "A broader issue related to the restructuring is one that has arisen each time the Space Station Program has been changed and planned capabilities have been eliminated or deferred, and that is whether the remaining capabilities justify the planned expenditures.

The difficulty in addressing this issue in the aftermath of the latest restructuring is that there is no longer a commitment to an assembly completed Space Station. Thus, it is now almost impossible to judge whether the cost to achieve a given Space Station ability has decreased or increased as a result of the restructuring."

How would you address that?

Dr. LENOIR. The previous configuration we called "assembly complete" we no longer define. We have submitted a detailed plan that takes us up through the permanently manned configuration as portrayed in our picture on this side of the room, here. We remain committed to developing an eight-man capability and growing to 75 kW and for that matter we remain committed to evolving and growing beyond the turn of the century in the ways that make sense based on our early knowledge and our early data gathering.

We don't think it is proper at this point, we believe it would be immature to try to be specific in detail a configuration that we would be building towards, say, in the year 2005, because we would not allow ourselves to learn in the next five to ten years. We remain committed to growing beyond this permanently manned configuration and specifically 75 kW and eight crew capability, we wish to grow back to that capability as soon as we can afford it.

AVAILABILITY OF ASRM SUPPORT STATION ASSEMBLY

Mr. NAGLE. I have one last question. It has been a troubled program, I think we all understand that. I don't know which commercial it is that says "Just do it," but I am almost at that point, you know, let's just do it. I did have to note here, as a minority of one on the committee, that your reliance on the ASRM, on six flights in 1996 of the ASRM, is going to be required and four more flights out through 1998 and 1999.

Obviously, since we don't have a construction schedule from you at this point, because you don't have one, it is kind of hard to see how we can rely on something that we have not built and don't know when it will be done. We don't know, although you use the figure 12,000, that is said in some circles to be somewhat optimistic. We don't know if we will have lift capability from the thing when we get it built, if we get it built when we think we will get it built, and we don't know when that is.

Can you address my concern? I am probably unreasonable.

Dr. LENOIR. No, sir, not at all. As we said earlier to Mr. Hall, we do indeed owe you the report from our ASRM study. We should have that in a couple of weeks.

I should point out that last night we burned our first 48-inch test motor as a part of the advanced solid rocket motor program, and while we will spend several weeks analyzing that data in detail, it appears that it behaved every bit as we had anticipated.

Mr. NAGLE. But we are planning a launch schedule based on something we don't have yet. That's the part that concerns me.

Mr. THOMPSON. We certainly have a lot of development work to do on the ASRM. We have discussed your concerns with you, and I believe we have factored all that into the schedule we have on the Space Station. I think we can lay out, assuming we can get through this funding issue in 1992 with the Congress on the ASRM and the schedule that is compatible with that, then we can lay out the schedule of the assembly flights on the station, in the development plan and the flight plan for the ASRM.

Mr. NAGLE. If that's the case, and you are going to do that in the future, why do I have this schedule from you saying when the ASRM is going to be used if we don't know when it will be done?

Dr. LENOIR. That is the basis of the assessment we are undergoing today on the ASRM, to make sure we have an ASRM schedule that supports that schedule.

Mr. NAGLE. I think we agree there is a quirk there.

Dr. LENOIR. We have not totally closed that loop. We need to do that. We have indicated that if for whatever reason the ASRM does not support that schedule then we would plan to follow those flights with a logistics flight in order to bring up the rest of the mass.

Mr. NAGLE. Of course, you could take that $2 billion in the ASRM and put it back into Space Station capability. That's a thought I will leave with you.

Thank you very much.

Mr. HALL. The Chair recognizes Mr. Browder.

Mr. BROWDER. Thank you, Mr. Chairman. I would like to follow up on a few specific concerns and questions of my colleagues up here, Dr. Lenoir. I would like to give you an opportunity to respond directly to a broad question. We have heard questions and comments about commitments to our use of communities, the life sciences centrifuge, the node to accommodate the facilities, we have questions about the assured crew return vehicle and the advanced microgravity materials experimental facilities.

In light of these questions, in a broad statement, would you respond to my question on what basis do you state, on page 3 and 4 of your testimony, do you state that the restructured space gives the first priority to life sciences?

Dr. LENOIR. First priority to life sciences may be a little misleading if you try to look at it in a chronological sense and see how we get there. The Space Station has to be looked at in a broad sense, as you point out, in the National objectives and in the long-term. In the long-term where is this Nation going? How does the Space Station support that? The permanently manned configuration, which is the focal point of having people permanently in space, around the turn of the century, provides us a unique capability to

support life sciences, to understand human physiology, to get smart enough to prepare to leave the Earth's environment with people and make longer-term missions.

To that extent we have focused on supporting the life sciences to enable that and take that then to say that that is our highest priority in that time frame. That does not mean that's where we start. We obviously are supporting a broad constituency of users, and in particular the materials microgravity sciences, which we happened to get to first, our man-tended configuration is best suited, better than the permanently manned configuration, for supporting the early research into materials and how they behave and the processes that develop them in microgravity.

Mr. BROWDER. So what you are saying is that these problems or these concerns that have been expressed do not detract from the priority given to life sciences, that you still can establish life sciences as a priority?

Dr. LENOIR. Yes.

Mr. BROWDER. Then these are just problems that you live with?

Mr. LENOIR. We don't see them as problems. We see that we have a multi-capable Space Station and indeed we can meet all of those requirements simultaneously.

Mr. BROWDER. Thank you, and thank you, Mr. Chairman.

Mr. HALL. Thank you for staying within your time constraints. We don't want to have to——

Mr. NAGLE. Hey, I stayed within mine. That's unusual. [Laughter.]

Mr. HALL. I meant to ask you if the Canadian arm, being in and out during the configuration, was an NBD? Was it or not? Does any of the group know?

Mr. NAGLE. Pardon me?

Mr. HALL. I am glad to get something you don't know—"No Big Deal." [Laughter.]

You did good, Mr. Nagle. The Chair recognizes Mr. Smith from Texas, my colleague from Texas.

SKYLAB COSTS VERSUS STATION COSTS

Mr. SMITH. Thank you, Mr. Chairman. Dr. Lenoir, I would like to pursue the question of cost from a couple of different angles. The first one is, it cost the United States almost $7 billion in 1986 dollars to construct and launch Skylab, which accommodated only three astronauts. The projection is that it will cost three times that amount to construct another Space Station that will accommodate only one more astronaut. Quickly, why is that?

Dr. LENOIR. The numbers you compare, when you say three times that, includes a lot more than the development. That includes several years of operations as well as the transportation costs, which I believe were also in the Skylab numbers. Don't forget that Skylab was operated on three distinct missions, 28 days, 56 days and 84 days in duration. The Space Station we are discussing will be operated somewhat like that intermittently from the man-tended capability up through the permanently manning, about a three year period on our current plan.

But once we get to permanently manning, we will have a crew of first four and eventually eight there, 24 hours a day, 365 days a year.

Mr. SMITH. The comparison would be three and eight, not necessarily three and four.

Dr. LENOIR. And I would also look at the duration of the mission, which is for decades versus a few months.

The chart that Marty Kress just put up here is one that is in the little four-page handout that is in front of you that compares this Space Station, the last two columns, first man-tended and then permanently manned, to previous Space Station or Space Station-like facilities, that have been in orbit.

Mr. SMITH. Let me go to my next question insofar as cost goes, and this goes back to your testimony last year before the NASA Authorization hearing then. You were asked by a colleague of mine "What is the price tag now on building the Space Station in fiscal year 1991 dollars?" Your response was "It is $16.6 billion in fiscal year 1991 dollars." The subsequent question was "And you would stake your personal reputation on that to a 95 percent level of confidence?" You responded "You bet."

Dr. LENOIR. Yes.

Mr. SMITH. It seems to me that something happened. I will assume it was not to your reputation, it was to the cost. How do you square your estimate then with the additional costs?

Dr. LENOIR. The first thing that happened was that the request we had for $2.45 billion turned into $1.9 billion, along with instructions to go take $6 billion more out of the program and as we have explained, we have done it really three different ways. We have descoped the program, we have simplified it, taken things out, we have expended some reserves and we have stretched out the schedule. When we stretch the schedule out, it gets more expensive.

Mr. SMITH. Nevertheless, what I am trying to do is—do you agree your figure of $16.6 billion is still accurate in 1991 dollars, the statement you gave last year?

Dr. LENOIR. The $16.9 that we have now is the development cost I have to compare to that. If I put it in 1991 dollars, it is $15.1.

Mr. SMITH. So you are saying your answer last year was correct, that everything else is due to the add-ons you were not thinking about at the time?

Dr. LENOIR. That's right. We believe this one is less expensive to develop, a good bit less because we have simplified it. It increases back up to almost the old number because of the schedule stretchout. But we still believe the numbers we told you last year were attainable, given the budget that was requested with it.

Mr. SMITH. So the add-ons added to the cost and you can still get it back to the $16 billion?

Dr. LENOIR. The add-ons are actually take-offs, because we have simplified it as we have gone through the restructuring.

Mr. SMITH. All right. Thank you, Mr. Chairman.

Mr. HALL. Thank you, Mr. Smith. The Chair recognizes the gentleman from California, Mr. Packard.

Mr. PACKARD. Thank you, Mr. Chairman. Unfortunately, I was detained, and I presume that all opening statements will be entered into the record.

Mr. HALL. Without objection, yours certainly will be entered into the record.

Mr. PACKARD. Thank you very much.

[The prepared opening statement of Mr. Packard follows:]

STATEMENT OF
THE HONORABLE RON PACKARD (R-CA)
SPACE SUBCOMMITTEE
HEARING ON THE SPACE STATION AND
THE NEW LAUNCH SYSTEM
9:00 A.M., 2325 RHOB
APRIL 11, 1991

THANK YOU MR. CHAIRMAN:

FUNDAMENTAL PROBLEMS HAVE BEEN IDENTIFIED WITH THE SPACE STATION. I LOOK FORWARD TO TODAY'S HEARING SO THAT WE CAN ADDRESS THE PURPORTED INABILITY OF THE SPACE STATION TO SUPPORT LIFE SCIENCES RESEARCH AND MICROGRAVITY RESEARCH. HOPEFULLY THE RESTRUCTURING EFFORTS HAVE TACKLED OTHER CONCERNS SUCH AS THE LONG-TERM FEASIBILITY OF THE FUNDING APPROACH AND THE POTENTIAL INSTABILITY OF THE PROGRAM MANAGEMENT STRUCTURE.

WE WILL ALSO LOOK AT THE NEW LAUNCH SYSTEM. THE POTENTIAL FOR DRASTIC REDUCTIONS IN THE NEW LAUNCH SYSTEM'S AUTHORIZATION GIVES ME CAUSE FOR GREAT CONCERN. A DRAMATIC CUT FROM THE PRESIDENT'S REQUEST FOR FY92 SHOULD NOT BE ENTERED INTO LIGHTLY. I MERELY ASK THAT WE ANALYZE THIS PORTION OF THE BUDGET CAREFULLY AND NOT HASTILY SLASH THE AUTHORIZATION LEVEL FOR THIS IMPORTANT SYSTEM.

Quality of Work at Space Station Level II Program Management Office

Mr. Packard. I would like to ask, are you satisfied with the quality of the work that is being done at the Space Station Level II Program Management Office?

Dr. Lenoir. Yes, sir.

Mr. Packard. You have had no problems in the transition from Johnson to Reston?

Dr. Lenoir. We did have difficulties completing that transition, and that happened over a number of years. But those are well behind us. As I have told both Dick Kohrs and Bob Moorehead, sitting at the table with me, throughout the past year I think the activities of our program office have been outstanding.

Mr. Packard. One of the objectives in making that change, as I recall, was that it would allow us to have a separation and perhaps an independence and an impartial management structure. Has that worked out to actually accomplish those objectives?

Dr. Lenoir. I would say in part it has with respect to providing that independence, it definitely has over the past several years, three years, one of our conclusions is maybe too much so. In the engineering side, several years ago we did not do the quality and depth of systems engineering we would have wished today with perfect hindsight and some of the activities we have had to get into over the past year have pointed that out.

Mr. Packard. I have just heard rumors that the thought of moving back to Johnson is being tossed around at NASA. If there were a change back considered, what kinds of costs would we be looking at and what kinds of changes would that make in terms of delays of programs that are on line?

Dr. Lenoir. We are currently reviewing our organization and management structure, which frankly is something that we do every time we pass a major milestone. We have just passed the preliminary design milestone and as we finish the next several months, and in the October time frame complete the phase review of our permanently manned configuration, we will be getting completely then into our detailed design. That requires a different set of skills and experience in order to manage the program. We are reviewing that and seeing how best to supply that.

In addition, we are responding to recommendations from the Augustine Commission on separating development and operations and we are also taking a look at lessons from the space shuttle program, as we have continued to transition it from a development program to an operations program. We all know that has not been as smooth as we originally thought, and the difficulty in separating the development from the operations to become a smoothly running operations program. We have lots of lessons there.

We are reviewing all of these as well as looking ahead in the Space Station Program and saying that when we are permanently manned, how do we want to operate it? What should our organization look like? As we go through the assembly, how should we be organized? How are we organized now and what is the best way to get there from here? What is the right first step?

So it is a fairly complex undertaking we are reviewing, which is why we have spent so much time on it. There has been, as J.R. pointed out earlier, no conclusion to date. My study is not complete and I have not made a definitive recommendation to J.R. and Admiral Truly. Hopefully we will be drawing that to a close in the next month or so.

But I would anticipate some changes. It is no way reflective of the people or the quality of work, which for the past year has been outstanding.

Mr. PACKARD. Do you have any estimates at this early time as to what costs it would be and how it would affect problem delays?

Dr. LENOIR. That's one of the things that is going into our study. We are looking at not only the up front costs, but we are looking at it from a life cycle cost point of view with the budget pressures to make sure we have an organization that allows us to have the lowest reasonable overhead and manage our program successfully.

Mr. PACKARD. If relocation is considered and all your reviews indicate it would be advisable, would that, on a timing basis, I think some of the independent panels that have done some reviews have indicated it would be most effective during the operational phase of the Space Station, or somewhere after 1996. Is that reasonable?

Dr. LENOIR. Certainly as we go into operations, it is reasonable to assume there would be organization changes required in that time frame. The question we are addressing now is are there organizational changes that are advisable now that will make those we have to look at later easier to implement.

Mr. PACKARD. My hope, because of budget constraints, would be that the cost and the slippage of ongoing programs would be factored in carefully and that the decision would be made from a budget issue and from an operational issue and not a political issue. I would hope the political aspects would not become a factor.

Dr. LENOIR. Absolutely. We agree. It is a technical issue, we must get the job done, we must build this Space Station and do it efficiently. The cost is a major consideration and minimizing hurt to any of our personnel.

Mr. PACKARD. Thank you. One last question, if I may, or I can ask it later after we go through the cycle, whatever your pleasure.

Mr. HALL. I know you will ask it quickly.

Mr. PACKARD. I will.

In our budget, or in the President's budget proposal, which I think is perhaps your budget proposal, you have $122 million budgeted for the assured shuttle availability. Our budget proposal, our committee's budget proposal, is recommending a $10 million reduction. I would be interested in your evaluation of what that would do to that program.

Dr. LENOIR. As I recall, that reduction is specifically aimed at what we call the MEDS. It is a multi-function cockpit display and controls in the space shuttle orbiter. We have that upgrade in because our experience says that the cathode ray tubes, the tape meters and the controls and displays that the commander and pilot use to fly the shuttle, as they just did when we landed, are becoming more expensive to maintain and keep operational.

As we try to look ahead, we see that in five or six years, that will become a major problem with potential ability to slow down our

flight rate if we can't keep up. We have looked at that and said we would like to replace those. That program is the first $10 million that would implement that over a four or five year period.

Mr. PACKARD. What effect would deferring MEDS have?

Dr. LENOIR. It would defer it at least one year, and increase the likelihood that that could be a problem that would slow down our capability to fly space shuttles in the mid to late 1990s.

Mr. PACKARD. And that's the very time when we will probably be using them significantly to get the Space Station up?

Dr. LENOIR. Yes, that's correct.

Mr. PACKARD. Thank you very much, Mr. Chairman.

Mr. HALL. Thank you, Mr. Packard. The Chair recognizes at this time Mr. Cramer of Alabama.

Mr. CRAMER. Thank you, Mr. Chairman. I have a stimulating opening statement which I would like to submit for the record. I won't bore you with reading it at this point.

Mr. HALL. Without objection.

[The prepared opening statement of Mr. Cramer follows:]

OPENING STATEMENT OF BUD CRAMER
SPACE SUBCOMMITTEE
NASA SPACE STATION HEARING
APRIL 11, 1991

THANK YOU MR. CHAIRM[illegible] I AM STRONGLY COMMITTED TO THE SPACE STATION FREEDOM PROGRAM. A PERMANENTLY MANNED SPACE STATION, COMPLETED BY THE END OF THE DECADE, WILL HELP INSURE THE LEADERSHIP OF THE UNITED STATES IN SPACE. OPENING UP THE FRONTIERS OF SPACE IS IN OUR NATIONAL INTEREST AND ESTABLISHMENT OF THE STATION IS ONLY THE BEGINNING OF THE SPACE EXPLORATION INITIATIVE AND A VITAL PART OF OUR MISSION FROM PLANET EARTH.

THE SPACE STATION WILL PROVIDE INVALUABLE INFORMATION AND EXPERIENCE RELATING TO THE NEEDS AND REQUIREMENTS OF LENGTHY MANNED VISITS TO SPACE. THIS IS IMPORTANT AS A FIRST STEP TOWARD OUR RETURNING TO THE MOON AND HUMAN EXPLORATION OF MARS. THE ABILITY OF THE STATION TO BE EXPANDED IN SCOPE IN THE NEXT CENTURY WILL ALSO HELP ACHIEVE THESE GOALS.

SPACE STATION FREEDOM WILL PROVIDE US WITH SCIENTIFIC OPPORTUNITIES NOT AVAILABLE ON EARTH. WE WILL BE ABLE TO CONDUCT MICROGRAVITY AND LIFE SCIENCES RESEARCH FOR A VARIETY OF USERS THAT IS UNPARALLELED.

THE SPACE STATION IS TRULY AN INTERNATIONAL EFFORT LED BY THE UNITED STATES AND I WAS PLEASED TO SEE THAT ALL OUR INTERNATIONAL PARTNERS HAVE REVIEWED THE RESTRUCTURE AND SUPPORT IT. I AM VERY

PLEASED WITH THE RESTRUCTURE EFFORTS NOW CONCLUDED BY NASA AND LOOK FORWARD TO HEARING FURTHER TESTIMONY TODAY ON THE RESTRUCTURE OF THE STATION.

I STRONGLY SUPPORT FULL FUNDING FOR SPACE STATION FREEDOM SO THAT WE MAY ACHIEVE PERMANENT MANNED CAPABILITY BY THE END OF THIS DECADE AND I URGE MY COLLEAGUES TO UNANIMOUSLY SUPPORT THIS PROGRAM.

THANK YOU MR. CHAIRMAN.

Mr. CRAMER. I want to commend the panelists, I know most of them. J.R., I probably will direct this question to you. Has there been any change in the division of the work packages among the centers with the restructure?

Mr. THOMPSON. The fundamental assignments to the work packages, no. There will be some streamlining as we go through in terms of various equipment, but I think the first order is that we are still on the course we started.

Mr. CRAMER. At the risk of beating a dead horse, Dr. Lenoir, the Space Station Level II office in Reston—were you speaking to it in the previous questions about the decision of where to locate that, or if that will be relocated anywhere?

Dr. LENOIR. That was a part of the answer, yes. I was speaking in a more broad term with respect to the overall Space Station organization and management, but most of that is focused on our program office and that activity currently in Reston.

Mr. CRAMER. Do you have any idea when that decision might be made?

Dr. LENOIR. As I said, it is a very complicated decision. It gets back into what we are doing today on the space shuttle, and how we are trying to become more efficient in the operations. A broader study reacting to the Augustine Commission recommendations to separate operations and development—but I would hope in the next month or so.

Mr. CRAMER. Okay, thank you. Thank you, Mr. Chairman.

Mr. HALL. That was really the way to ask questions and get them behind you.

Mr. CRAMER. Thank you.

Mr. HALL. It was stimulating.

Mr. CRAMER. I learn quickly, Mr. Chairman.

Mr. HALL. All right. We have a Chairman Emeritus, is that a good name for Mr. Volkmer of this subcommittee, Dean of Space? We recognize you, Mr. Volkmer.

Mr. VOLKMER. I would like to continue on, Dr. Lenoir, with the question that was just asked. Are you telling us that within a month and a half you will be able to make a decision, NASA will make a decision as to whether or not to continue the development stage for the Space Station, the development program for the Space Station, at Reston, or to move it to Houston or someplace else?

Dr. LENOIR. What I would like to say is that there is no question that we want to proceed with the development of the Space Station and are proceeding with the development of the Space Station. We are looking at some organizational changes that we will not allow to have an effect on the schedule. That is one of the constraints. We will not undergo any kind of a reorganization that will be allowed to slow our progress down a bit.

The highest priority work in front of the Space Station Program today is to complete the preliminary designs and the phase reviews for our man-tended configurations and our permanently manned configuration in the October time frame. Nothing we do will be allowed to interfere with that or slow that down.

But we are looking at some organizational changes within implementing this program.

Mr. VOLKMER. Mr. Chairman, I think the gentleman from California has some reservations, and I know I have some reservations about what I have been hearing will possibly occur. I don't know exactly what to do about it, at least I think we should have a full report from NASA when that decision is made, and given to us in a timely fashion, so in the event we have some disagreement, the Congress may decide to do something about it.

I have heard not only that you are making this study and reorganization, but I have also heard that there have been some letters written by a certain delegation in regard to it also. I have not confronted any of those people with that, but if that is true, then I have some problems with it. Do you understand?

Dr. LENOIR. Yes, I understand, and as I said earlier, our criteria, as we consider our organization, are technically and managerially we must get our Space Station Program done and we must be organized to do that as efficiently as we can. We want to minimize the cost and minimize our overhead. We want to make sure we have high morale and a happy work force. That's the end of our criteria list.

Mr. THOMPSON. Congressman, let me assure you that I think NASA is going to do what the right thing is, that needs to be done. We have to keep the program going forward. I think Bill is working hard relative to bringing his recommendation forward. Dick Truly is going to make the decision, and I am sure we will be getting back to this committee and the key members of the Congress relative to the decision we reach.

Mr. VOLKMER. The reason I asked is because there was a delay factor when you did move from Houston up here, up to Reston, wasn't that right?

Dr. LENOIR. There was a delay there, but that was a somewhat different situation in that we were moving from established centers into what was largely at that time a vacuum. I do not envision that we are going to be totally shutting down anyplace and moving en masse anywhere else.

Mr. PACKARD. Would the gentleman yield for just a moment?

Mr. VOLKMER. Yes, I would be glad to yield.

Mr. PACKARD. That move was made subsequent to the Challenger accident.

Dr. LENOIR. Right.

Mr. PACKARD. And it was made, I think, as a result of the review process of the management structure that resulted from the study of the *Challenger* accident. Hopefully, those changes that were made and the move that was made at that time will be considered in the same light, to improve the ability to avoid another *Challenger* type of accident because of management structure.

Again, I simply reemphasize—if the gentleman will continue to yield—that it needs to be other than a political decision. I think he has said it as well as I could. But it just cannot become a political decision. I am not worried about this——

Mr. THOMPSON. It is not. It will be a well considered decision that we make——

Mr. PACKARD. I am not worried about this committee, I am worried about other committees of the Congress that will put the kind of pressure on NASA to make it a political decision.

Thank you for yielding, sir.

Mr. VOLKMER. Dr. Lenoir, would it be possible that at the time you make this submission to Admiral Truly that you furnish some of us, those who want it, a copy of that recommendation?

Dr. LENOIR. I don't think that——

Mr. VOLKMER. I don't want it after Admiral Truly has had it and had time to look at it and made the decision that—I don't want it when the horse is out of the barn running down the road. I want it before the horse gets out of the barn.

Dr. LENOIR. I understand. But I don't think that I can give it to you at the same time I give it to Admiral Truly. Admiral Truly is a very near and dear friend of mine. I know him well enough to know he is not going to agree with everything in there and we will probably have a few changes to make ourselves. He may send me back to the drawing board and tell me that it's the dumbest thing he has ever seen and to go and fix it.

Coming out of there, when we have a NASA position, we certainly ought to consult and share that with you before that has become public.

Mr. VOLKMER. In the event it is decided that part of the operations at Reston, whatever it be, the development on the Space Station, etc., in the event that it is planned to move part of that operation to some other location, when would it be your thought that those transfers would begin?

Dr. LENOIR. The transition timing would certainly have to be a part of our proposal for how to do it. I would not envision that this happens quickly. The first few might happen right away, but I believe this would probably take one or two years to complete in an orderly fashion, if indeed we decided to move any major chunks anywhere.

Mr. THOMPSON. But since we have not seen this plan and it has not been through NASA yet, I don't know how to answer that question. I can commit—and I know if Dick were here he would do the same thing—and that is we will closely coordinate with the appropriate committees of the Congress the decision we feel is in the best interest of the Space Station Program.

Mr. VOLKMER. Of course, there is one way we could put in there that you could not begin it without approval of the Congress, too. That's another thought, I don't know if I want to do that.

The other thing I am concerned about—I know my time is past due——

Mr. HALL. We recognize you to complete your questions. I think Mr. Packard has used part of your time.

Mr. VOLKMER. Maybe I am rehashing something others have gone over, but it appears to me from reviewing the restructuring that we won't be doing any life sciences until after the year 2000. Correct?

Dr. LENOIR. No, that's incorrect. We have a space shuttle mission that will be launching in May that will be our first space life sciences mission based on the space lab. That will be the first of these series of life sciences missions that will continue and transition to the man-tended Space Station and then grow further and longer as we go into the permanently manned.

Dr. FISK. Yes, there are a number of things we are going to be able to do over the next decade. You are correct in your statement that the real strides forward towards sending people out into space, the Moon, Mars, whatever, has to await PMC. We need long duration space flight.

Mr. VOLKMER. And you aren't going to keep anybody up there in the space labor for six months?

Dr. FISK. That's correct.

Mr. VOLKMER. You can't do it without a permanently manned station?

Dr. FISK. That's correct.

Mr. VOLKMER. That's what I am talking about.

Dr. FISK. There are interesting life science precursor activities that will occur. But yes, you have to get the PMC.

Mr. VOLKMER. Fine. When would you begin your commercialization use of the research on microgravity aspects? When would we start using the station for that?

Dr. FISK. That you can start in earnest essentially with the man-tended capability, which is——

Mr. VOLKMER. In 1997?

Dr. LENOIR. Yes, mid-1997.

Dr. FISK. In mid-1997. The real difference here, just so we all understand, is that we have the opportunity during the man-tended capability to leave things to develop between shuttle flight visits in the material science. You really do not have that option effectively in life science, because you would not leave animals, for example, on a station where there were no folks. So the material science has an opportunity to take advantage of this, and we plan to let that happen.

SOLAR DYNAMICS

Mr. VOLKMER. And, I notice in your statement here, somebody talked to you about the solar dynamics, we are almost abandoning solar dynamics?

Dr. LENOIR. We are not abandoning them, just concluding that we can't afford them.

Mr. VOLKMER. Can't afford it. In other words, you say maybe like other things, as we expand that Space Station after the year 2000, we will get back into it?

Mr. THOMPSON. It is being deferred to a later time frame, that's correct.

Dr. LENOIR. In some of the key technologies, research continues in our Office of Aeronautics, Exploration and Technology, into some of the key technologies, in particular some of the thermal energy storage that would be useful as we go forward beyond the year 2000. But in our currently configured Space Station, we do not have solar dynamics.

Mr. VOLKMER. And we don't even have 75 kW, do we? Is it 56?

Dr. LENOIR. We have a little under 60 kW total, but because of the way we have downsized the Space Station, at the permanently manned configuration we can still provide 30 kW to the users, which is the same 30 kW we previously had promised.

Mr. VOLKMER. Thank you, Mr. Chairman.

Mr. HALL. Thank you, Mr. Volkmer. You just really gave Mr. Slaughter more time to be called up and ready to go. The Chair recognizes the gentleman from Virginia at this time, Mr. Slaughter.

Mr. SLAUGHTER. Thank you very much, Mr. Chairman. I do not have any questions.

Mr. HALL. Thank you, sir.

First, let me just say that I think it would be a shame if we had to put a rider in that would require you all to notify us of any move or any major forward step. I know the gentleman from Missouri knows exactly how to do that, and there would be others who would. We are partners, not adversaries.

Keep us advised, and keep the gentleman from Missouri advised of the changes you hope to make. Logically, being a Texan, I hope you will give full consideration and take input from all parts before you move Reston to Houston, Texas, or Dallas, or El Paso.

Mr. VOLKMER. Will the Chairman yield?

Mr. HALL. Or St. Louis. [Laughter.]

Mr. VOLKMER. I don't anticipate that, but as the gentleman from California has more diplomatically said, I don't envision our space program and one of the things that would probably—I think I have been a pretty good supporter of it through the years. One of the things that would probably sour me completely on it is if this program became a jobs program for certain areas. If it does that, then boys, you can go home, as far as I'm concerned. Forget the whole thing.

Mr. HALL. I think Congressman Slaughter and Congressman Boucher from Virginia have expressed concern about any such move. Let me just briefly ask you, in a letter to Dr. Lenoir that was made public this week, I understand the senior managers of the Level II program office, including Mr. Moorehead here, had expressed their feelings about that and used the words that if you did move it, it would "invite calamity."

Have you answered that letter, and if not, if Dr. Fisk and Mr. Kohrs would move back and you give Mr. Moorehead an answer to the letter from all those managers?

Dr. LENOIR. I have not answered that letter in writing and may very well not, in that the way we do business is in a face to face, verbal manner. We have discussed the content of that letter, we have had many discussions and continue to work on the problem we are all focused on. We don't all see eye to eye. When we are finally there, decisions will be made and we will implement what we collectively feel is the best for the agency and the country.

Mr. HALL. I know you will do that. You have a history of doing that. It seems to me, and to Congressman Boucher, and I think I have heard Mr. Slaughter express the same thing, the people there who are the general managers at that level would know of the damage to the program to summarily move something like that, and at the cost of $20 million a month, that is $240 million a year—what, $200 million a month?

Is that right, Mr. Moorehead? You can project that out to what the annual cost or the slippage would be, and we are in a period of apparent frugality in Government. You can't just pitch your brief-

case on the table and tell Congress what you want any more. I liked the days when you could. But we can't do that anymore.

So please keep us advised, and keep the senior members of this committee, like the gentleman from Missouri, Mr. Volkmer, and Chairman Brown, advised. They will advise the rest of us if you do that. We are in a partnership, and we are not adversaries. We don't want to get in an adversarial position.

Mr. THOMPSON. Mr. Chairman, I can assure you we will do that.

Mr. HALL. Thank you.

NASA's Concerns With Committee Budget

Mr. PACKARD. Mr. Chairman, before you dismiss the panel, may I ask one question of them?

We are going from this hearing into our markup of the budget. Is there anything else in our committee's budget proposal that you would like to respond to before we go into the markup? I would be interested in any response or reaction from you, Dr. Lenoir, or J.R., or any of the members of the panel, that gives you heartburn as to where we are going on our markup.

Mr. THOMPSON. Let me start off. I know that fully funding this restructured Space Station is very critical to getting off on the right foot, and I think that's consistent with a lot of the concerns expressed by the panel. So that's a very high priority item with us that has not been marked as of yet.

Another item you have not marked, as I understand it, is a New Launch System, or a national launch system. The budgets are tight. But I think it is important that we start. It is a subject that we have talked about now around the country. It was well discussed within the Augustine Commission. It was reflected in their report. The critics that came before the Augustine panel all talked about it. I think it is time to start. And I think there are several ways to do that, and I would urge this committee to factor that into their discussions.

The EOS program is a very important program for this country. NASA is just a part of that. From the number that I saw of the cut, it struck me as off balance, but I am not sure I have seen the latest number. Those are three that would be most important, I think, in my judgment. I would encourage the committee to resist the add-ons that could come into this Space Station Program at a later date. I think certainly within NASA I can assure you that we are going to do it, we are going to stop that and get on with building the program we have proposed to this committee.

With that, let me yield to Bill and then to Len.

Dr. LENOIR. We have just gotten the data from yesterday and have not had time to look at it in detail. I would echo what J.R. said. Obviously one of our concerns is that we need to have the funding to adequately support the space shuttle program so we can operate it.

We do internally have activities going on to become more efficient and be able to fly at less cost. We want to continue those, but we do need to make sure we have the commitment and the funding to support the program to enable us to do that from the front side of the power curve rather than the backside. It is important that

we be ahead and on top of it, rather than being behind always trying to catch up.

The other thing is the Space Station Program as we have discussed today. We need the monies that we have requested, and I believe that there is fair acceptance of that, that we are cut to the bone as it is.

Mr. HALL. Mr. Packard, will that suffice?

Mr. PACKARD. I think Dr. Fisk wanted to respond.

Dr. FISK. I could not let an opportunity like this pass me by. Thank you. I would like to make two brief comments. J.R. mentioned EOS—I encourage you to reconsider the number you have on it. If carried to its extreme, particularly in the out years, it would cripple the program. Basically it would not be possible to conduct a meaningful global change research program.

I also encourage you to take a hard look at your considerations on the AXAF mirrors. There seems to be some misunderstanding on the committee's part or on the part of the staff. The mirrors are doing extremely well on the AXAF program. We are on schedule to meet Congressional milestones on that and there is no reason to slow down.

Mr. PACKARD. Thank you, Mr. Chairman.

Mr. HALL. Let me also say that I think we need to stay very close together on the station. I sure don't want to be the Chairman that presides over the demise of anything that important. I am concerned about the cuts. I have not seen exactly what they did to the Space Station.

In order to arm us with something with which to do battle, let me ask you just a few more questions regarding the station. When will you submit your revised capital development plan and your budget estimates for fiscal year 1993 and 1994?

Mr. KOHRS. At the end of May.

Mr. HALL. The end of May?

Mr. KOHRS. Yes, sir.

Mr. HALL. When will the restructured program reach the expanded permanently manned configuration? That's with the eight man crew and the full power, 74 or 75 kW? Do you have some idea about that?

Dr. LENOIR. In all honesty, we have no idea. The only answer I can give you is that it will be after the year 2000 and as soon as we can afford it after that. That depends on 10 or 12 years of budget appropriations that are hard to extrapolate.

Mr. HALL. When would you be able to refine those estimates?

Dr. LENOIR. In all honesty, I am not sure we could do much better than that until about 1995.

NEW LAUNCH SYSTEM

Mr. HALL. There has been some suggestion that you not proceed with a New Launch System, as you have described it, but instead go back and throw open the program to new design ideas by the commercial launch industry. You have heard those.

Dr. LENOIR. Yes.

Mr. HALL. How would you regard that?

Dr. LENOIR. I would regard that as somewhat of a step backward in that that is exactly how we initiated the joint Department of Defense and NASA—what we at the time called Advanced Launch System Studies was to look at all of those concepts and move forward based on the conclusions coming out of there.

We have, as we have put our current New Launch System concept together jointly with the Department of Defense, considered alternatives on the commercial side and the non-commercial side and have concluded that in order to best meet both of our evolving requirements into the next century, what we propose is the better answer.

Mr. THOMPSON. But the commercial launchers are very important to the future of our program, and as I have discussed with Congressman Rohrabacher, I know he has a big interest in this. We are staying abreast of what some of the companies are talking about, and I think we owe him and this committee a report as to where exactly we stand in our assessment.

Mr. HALL. Realizing your attitude toward it, and your somewhat opposing view on it, should it take place, how would you plan to involve industry?

Mr. THOMPSON. In terms of a national launch system, whatever it is, however it looks, industry is going to do it. NASA does not build, nor does the Air Force. It is the private sector in this country that will build that vehicle.

Mr. HALL. And discuss if you would what impact there would be if we eliminated the space transportation main engine, the STME program.

Mr. THOMPSON. Well, of course, that's the long lead item in that program, almost independent of how you configure the vehicle, because it would be an expandable LOX-hydrogen engine, which this country does not have today. So it is the thing we need to start next. It is part of the President's budget.

In the Augustine Report, to reflect back on that for a moment, they talked about the thin reed of transportation to space. They were encouraging the country, Congress and NASA, to start work in this direction and that is what our proposal is.

Mr. HALL. Just to get right down to it, what do you see as NASA's firm requirements for the New Launch System?

Mr. THOMPSON. The President's budget is $175 million. About $100-$110 million of that would be required to move out briskly relative to the advanced development leading into the development of the STME. That's the first thing you have to do.

Parallel with that, and you can pace this, would be the——

Mr. HALL. Connect that with program requirements, not just money.

Mr. THOMPSON. That would be the engine for that launch vehicle. That's the first thing you have to do, and that would be the money to get going on it.

Mr. HALL. Mr. Rohrabacher had some questions. I don't think it's your time next, but if you have something that relates directly to this, I will recognize you at this time.

Mr. ROHRABACHER. Just one question. We have heard today how the cost estimates by NASA have gone haywire in reference to the Space Station and there have just been totally unreliable cost esti-

mates over the years on what the project was going to cost us. Now I guess, Dr. Lenoir, you are suggesting that for us not to rely on the analysis of NASA and instead to put up for competitive bid to private industry to offer their analysis and their alternative in heavy launch vehicles, is a step backwards?

Dr. LENOIR. My point was that in arriving at this conclusion we think we have considered all of those in the past. To do it again is somewhat of a step backwards.

Mr. THOMPSON. Congressman, I would just add to that, the three major AIR engine developers in this country, Air Rocket, Dyne-Air Jet, and Pratt & Whitney, have all been working with us on the STME. The vehicle contractors have not been selected. There are teams that have been involved on and off in the activity. But I think how we do it and what it looks like is still all in front of us.

Mr. ROHRABACHER. Setting the requirements of what you are going to need, or what we will need in terms of putting it into space, and putting out to private bid to see who can do the best job at the cheapest price, considering that the cost overruns are, so to speak, or the misanalysis of costs in the Space Station Program, putting these things up for bid in the private sector and seeing who can come up with the best price seems like a pretty good idea to me and not a step backwards.

Thank you, Mr. Chairman.

Mr. HALL. I want to tell the panel that members come and go. Their arriving and leaving does not indicate an ebb and flow in interest in what you are saying. They just have a lot of other committees that are going on. One of the busy members of this committee is Mr. Lewis, the gentleman from Florida. We now recognize you for an opening statement, and you may want to ask questions.

Mr. LEWIS. Mr. Chairman, I have no statement and no questions.

Mr. HALL. Thank you for attending. Are there others for a second go-around?

Mr. VOLKMER. I would like to ask one more.

Mr. HALL. The gentleman from Missouri.

HEAVY LIFT VEHICLE

Mr. VOLKMER. J.R., when we talk about a heavy lift vehicle, the thing that concerns me is that we have dollar problems. If we put dollars there, somewhere along the line, someone else will be shortchanged. And when would we have this vehicle available?

Mr. THOMPSON. I think that will be paced by our ability to afford it. It is not going to be driven by the technology. We have been working on the STME or the engine, which is the long lead item now, for several years. But I think, being realistic, looking at the other budget pressures NASA and these committees have to deal with, I think you are talking in the range of 8 to 11 years, depending on the pace at which you feel you can afford it.

I would surely encourage us to factor in the total national requirements in that, which would include the Department of Defense. I believe in this system it should include some smart front end, as I call it, that would allow us to transport a payload to the station and perhaps also to increase our upper stage capability to

get the geosynchronous orbit. Again, we are going to be defining transportation needs for the first two decades of the next century.

Mr. VOLKMER. That's part of the problem, as I see it, putting money there and taking away there, we won't be using this probably until about the year 2000. Then what are we going to be using it for?

Mr. THOMPSON. As I have indicated, it is first of all going to be available and used in the time frame that we really begin to operate the Space Station. That dovetails with the requirements of the Department of Defense, as we have discussed with them. It helps us with a more robust space transportation system within NASA. It is at the very heart, if not the muscle, of the Augustine Report, and that is that NASA was too reliant, not now, but looking to the future, on the space shuttle. I think we have talked about that issue for far too long, and now we need to start.

Mr. VOLKMER. I may be wrong, but if we end up with a budget we are going to be voting on next week, and we have to cut out a half billion dollars from the figures we already have, do you have any suggestions?

That's all right. You don't have to make them. I don't know either.

Thank you, Mr. Chairman.

Mr. THOMPSON. We have a well balanced program put together, and I think we have done what we need to do and this committee I am sure will do what they need to do.

Mr. HALL. All right, are there other members who have additional questions?

Not to beat a dead horse, but what are the firm mission requirements for NLS? What are your firm mission requirements? If you answered me, I was not intelligent enough to understand it.

Dr. LENOIR. That's the difficulty. Unlike, as we talked earlier, the advanced solid rocket motor has a particular enabling function for a part of the Space Station Program, and that is to launch the modules fully outfitted. I can't do without the advanced solid rocket motor. There is no enabling function that the New Launch System provides to the Space Station in this earlier phase.

The New Launch System is proposed—we also refer to it as the National Launch System—in order to help us break our total reliance on the space shuttle as our only way to get large payloads into orbit and dock them with a vehicle such as the Space Station, and to provided us some way to offload the space shuttle, to back the space shuttle up, if you like, and to serve as the building block for continuing to grow to meet the unfolding requirements as we see them into the next century.

The first step of that has to be the new engine. Wherever we start, we have to get that new engine so we can get on with the vehicles we are going to build with that new engine.

Mr. THOMPSON. But there is no mission to a fixed time frame that requires the new National Launch System—it has to provide a capability——

Mr. HALL. But there is a time frame that makes sense, isn't there?

Mr. THOMPSON. That's correct.

Mr. HALL. There is no reason to have it and not use it for 9 or 10 years for Moon and Mars and not have it in time to build into the Space Station.

Dr. LENOIR. For example, if we had a New Launch System as we conceive it today, after we attain permanently manned capability, we think that we could take the four logistics flights of the space shuttle that would be supporting the Space Station—just to operate it, not the continued growth, but just to operate it—and replace those four shuttle flights with two shuttle flights and one flight of the new launch vehicle. That would allow us to do our crew rotations as well as provide logistics support.

In addition, as we look at attaining eight-man crew capability, the additional 75 kW and continuing to grow the Space Station, I then have the ability to think in slightly larger terms and do a better job with larger pieces.

Mr. ROHRABACHER. Mr. Chairman, could I ask one question?

Mr. HALL. Yes, sir.

Mr. ROHRABACHER. Dr. Lenoir, this new engine you consider to be a necessity, it is a necessity for projects that you believe will happen over 10 years from now, isn't that correct?

Dr. LENOIR. It is a necessity for a new launch vehicle.

Mr. ROHRABACHER. What I am saying is this idea that we need this heavy launch system and the absolute requirements that we have this new engine design is based on something on missions you believe will be happening over a decade from now, not between the next 10 years?

Dr. LENOIR. That is correct.

Mr. ROHRABACHER. Isn't it possible that new technologies will be developed in between now and then that will change the whole configuration of those missions and possibly the need for that engine?

Dr. LENOIR. It is possible. I would not say it is likely, but it is possible. The thing that drives is while we are talking about requirements that will unfold a decade away from us, we are also looking at an engine development that consumes a major part of the decade.

Mr. ROHRABACHER. I guess what I am saying is that would it not be possible that new technology, and frankly in the fast changing world we live in, I consider it not only possible but likely, that we will be coming up with new ways of accomplishing those missions that might make that engine and the investment we are talking about in this engine irrelevant?

Mr. THOMPSON. I don't foresee that at all. Lox-hydrogen is going to be the technology of the first several decades of the next century, and this is the engine, I think, for that vehicle, however, you size it. It is focused on reducing the cost and making it expendable, so it can have multiple uses. I just do not see anybody coming up with the technology that would outdate that.

Mr. ROHRABACHER. We are basing the support for the NLS on a need for a new engine, and not for a need---

Mr. THOMPSON. It is for a need of a new capability.

Mr. ROHRABACHER. How much is it going to cost to produce a heavy launch vehicle to get a certain amount of weight into a certain amount of orbit, isn't that correct?

Mr. THOMPSON. It will provide the system that we have been working on with the Department of Defense, then it will be going to the Space Council and then into the Congress. It will provide a range of payload capabilities, all the way from the current Titan IV up to the Heavy Lift, well over 100,000 pounds of capability.

It will focus on reducing the costs, I believe we will do that. And it will be able to evolve eventually for programs like the Moon, Mars——

Mr. ROHRABACHER. When you say reducing the cost, what you are really talking about is maybe reducing the cost well over a decade from now, not reducing the cost in terms of accomplishing our mission with the Space Station or some of these other factors.

Mr. THOMPSON. Where we are today, anything we are talking about is going to take some years to get started. We have been talking about this program now for three and a half years. We have made limited progress because of the funding issue. Again, it was right at the heart of this Augustine Report that had a wide audience that embraced it.

Mr. ROHRABACHER. There are those that are trying to promote the use of space and promote America's position in space by just increasing our potential to accomplish something in the near term, say within the next decade, by actually trying to develop heavy launch systems which will improve our capabilities. It seems to me that it is going to cost so much more, especially at a time when we are so strapped for money, in order to do something that may well be necessary in the decades ahead, isn't it better to get the job done we have in front of us?

Mr. THOMPSON. You have to look at the total objective. I believe it needs to be national in scope, it has to satisfy the DOD requirements. We have looked at, and you are well aware of this, earlier, cheaper configurations that do not evolve gracefully for future needs. So we think the program we are embarking on or are in the process of proposing is the right one. It is the right compromise——

Mr. ROHRABACHER. As you know, one of my complaints was that officially the alternatives have not been looked at, and that it is all——

Mr. THOMPSON. I assured you in my discussions, at our most recent visit, that we will do that, and I will provide you——

Mr. ROHRABACHER. Up until this time, I have not seen it.

Mr. THOMPSON. We are keenly aware of what has been going on across the country.

Mr. ROHRABACHER. Thank you, sir.

ALTERNATIVES TO NLS

Mr. HALL. What are the alternative means of satisfying the requirements and what would be the operational tradeoffs of any alternative to NLS?

Mr. THOMPSON. The configuration we have been looking at and studied in some studies approved by Congress deal with programs like Shuttle C, which would be to basically use the current shuttle's capability, replace the orbiter with a cargo module. That gives you the lift capability well in excess of 100,000 pounds to low Earth orbit.

It is expensive. It uses the shuttle main engines. It has a unit cost in the range of $30–$40 million. A copy, versus the STME that we talked about, once we get them, I believe will be $5–$7 million. So there are cheaper versions, but the operational expense is there and they do not provide for the growth beyond the turn of the century that we think is going to be required.

Mr. HALL. Are there other questions? Does anyone else have questions or suggestions?

[No response.]

Mr. HALL. The Chair recognizes that we have reached a point where we will continue our markup. We thank Marty Kress, who does a good job as liaison and former advisor to Senator Gore, for your presence here. We really thank you for your time and input, and we certainly will be staying very close to you in the days ahead. Thank you, Dr. Lenoir.

Dr. LENOIR. Thank you, Mr. Chairman. I would just like to close by saying that as we have said today, the Space Station is at a crossroads. We absolutely need your support and cannot succeed without it. We have told you what we think we need in terms of money. We have told you technically how we want to proceed and what it is going to look like. We absolutely depend on your support.

Thank you very much.

Mr. HALL. Thank you very much.

[Whereupon, at 11:20 a.m., the hearing was concluded, to reconvene at the call of the Chair.]

APPENDIXES

Responses to written questions submitted by Chrm. Brown resulting from the February 7, 1991, hearing.

QUESTION 1:

Which of the Augustine Committee's recommendations does NASA intend to implement? For those that NASA will implement, please provide an implementation plan and schedule.

ANSWER 1:

Enclosed is the NASA Action Plan as of March 11, 1991, for all recommendations of the Advisory Committee on the Future of the U.S. Space Program. It should be noted that NASA has sole responsibility for 20 of the 33 recommendations--the remaining 13 are interagency actions.

QUESTION 2:

In the posture hearing, Admiral Truly referred to Spacelab-J as a "cooperative" mission (see page 11), line 231 of the hearing transcript). In a letter from Admiral Truly to Mr. Brown, Spacelab-J was described as a "reimbursable" mission. Please define what is meant by the terms "cooperative," "reimbursable," and "joint," and what is different in the actual terms of agreement with international participants in each category of mission?

ANSWER 2:

The international activities that NASA undertakes fall into two general categories, cooperative and reimbursable. A cooperative activity is one in which there is mutual programmatic interest. In such arrangements, each partner agrees to fund and develop his own share of the project, e.g., an instrument, spacecraft or launch. Cooperative missions are sometimes referred to as joint missions.

A reimbursable arrangement is one in which one party agrees to pay the other for services, such as launch or tracking.

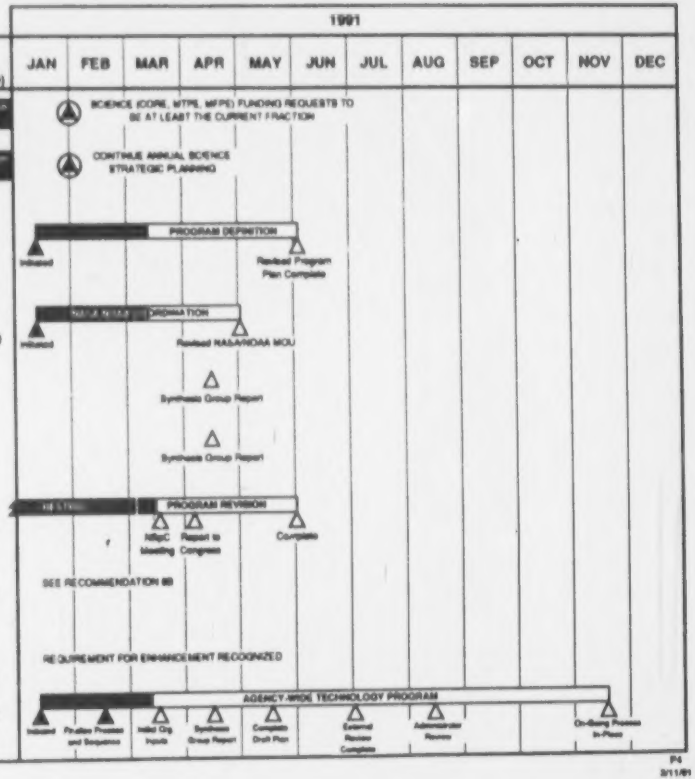
Both cooperative and reimbursable agreements spell out the responsibilities of each side as well as mutual understandings on such subjects as data rights and liability. Cooperative agreements further outline the management approach for a project and are based on the concept of no-exchange-of-funds. Reimbursable agreements, as the name implies, contain financial arrangements such as cost estimates, payment schedules and billing procedures.

Some international activities have a mixture of reimbursable and cooperative elements. An example of this is Spacelab-J. Japan paid for approximately 45% of a Spacelab mission in order to use the Spacelab for its own experiments. As part of this reimbursable arrangement, a Japanese Payload Specialist will take part in the mission. NASA is using the other approximately 55% of the Spacelab for its own experiments. In addition to these

THE ADVISORY COMMITTEE ON THE FUTURE OF THE U.S. SPACE PROGRAM

NASA ACTION PLAN

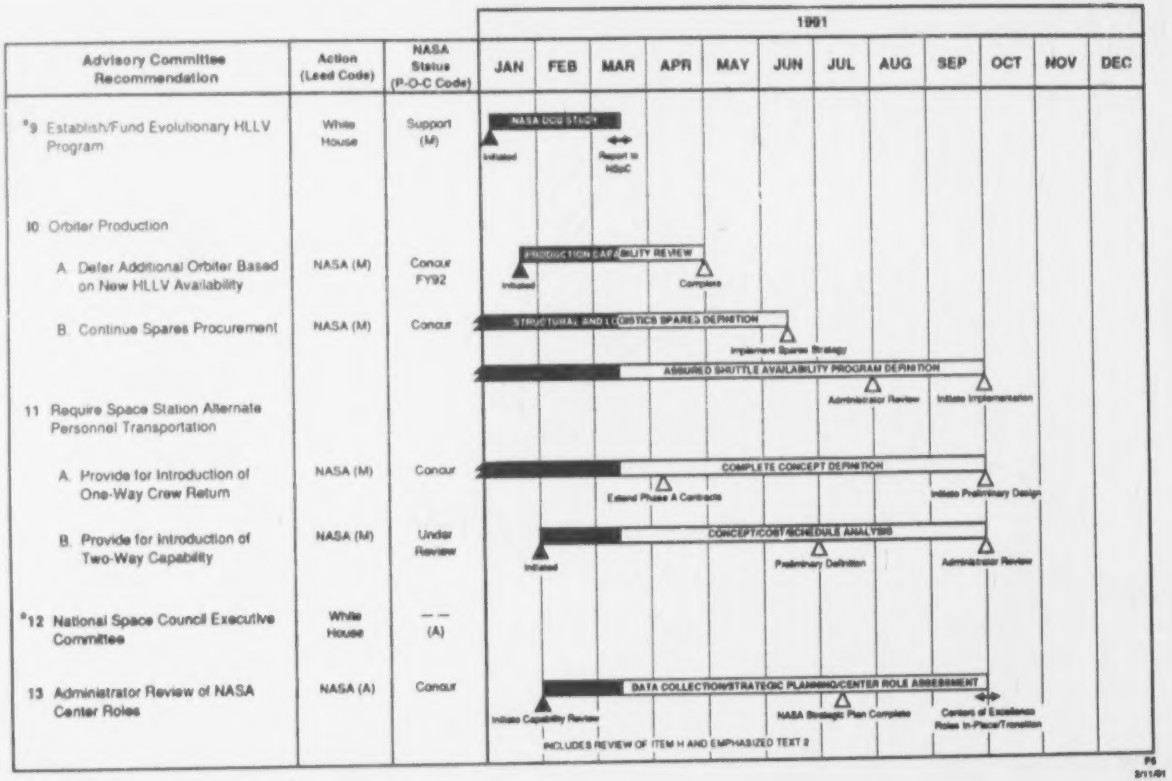
Advisory Committee Recommendation	Action (Lead Code)	NASA Status (P-O-C Code)
1 Science First Priority Funded at Current Fraction	NASA (S)	Implementation Approved
2 Implement Science Strategic Plan	NASA (S)	Implementation Approved
*3 Mission to Planet Earth		
A. Conduct as an Evolving Program	NASA (S)	Concur (Define)
B. Multi-sized Spacecraft		
C. NASA Re-establish Environmental Satellite R & D; NOAA Fund Production and Operation	NASA (S)/ DOC	Concur (Define with NOAA)
*4 Reaffirm Ultimate Goal of SEI as Human Exploration of Mars	White House	Support (R)
*6 Configure SEI to Open-Ended Schedule	White House	— — (R)
5 Reconfigure/Reschedule Space Station Freedom	NASA (M)	Concur (Define)
7 Pursue Technology to Enable Moon Outpost/Robotic Missions	NASA (R)	Concur (Define)
8 Augmented Advanced Technology		
A. Enhance Budget	NASA (R)/ OMB	Concur (Define)
B. Agency-Wide Space Technology Plan with Outside Review	NASA (R)	Concur (Define)



* Interagency

THE ADVISORY COMMITTEE ON THE FUTURE OF THE U.S. SPACE PROGRAM

NASA ACTION PLAN

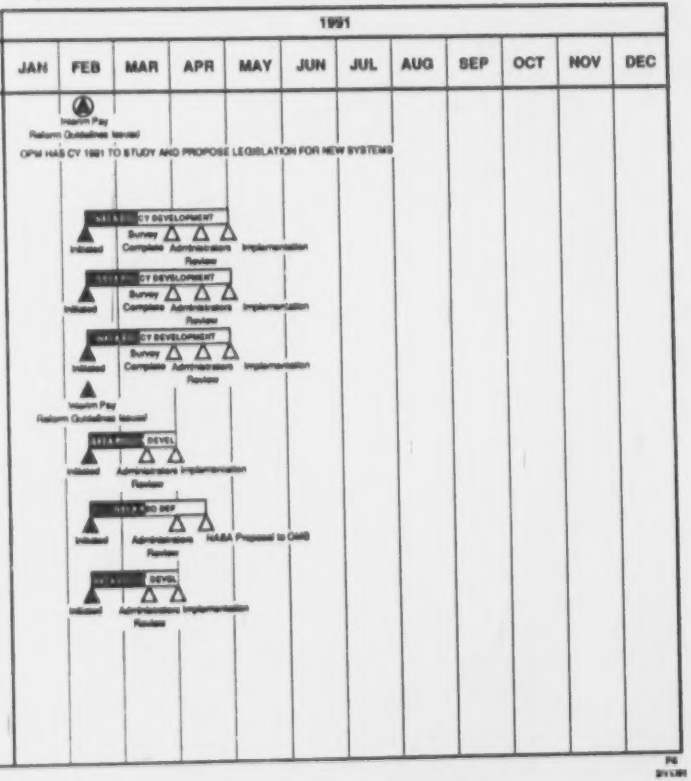


* Interagency

THE ADVISORY COMMITTEE ON THE FUTURE OF THE U.S. SPACE PROGRAM

NASA ACTION PLAN

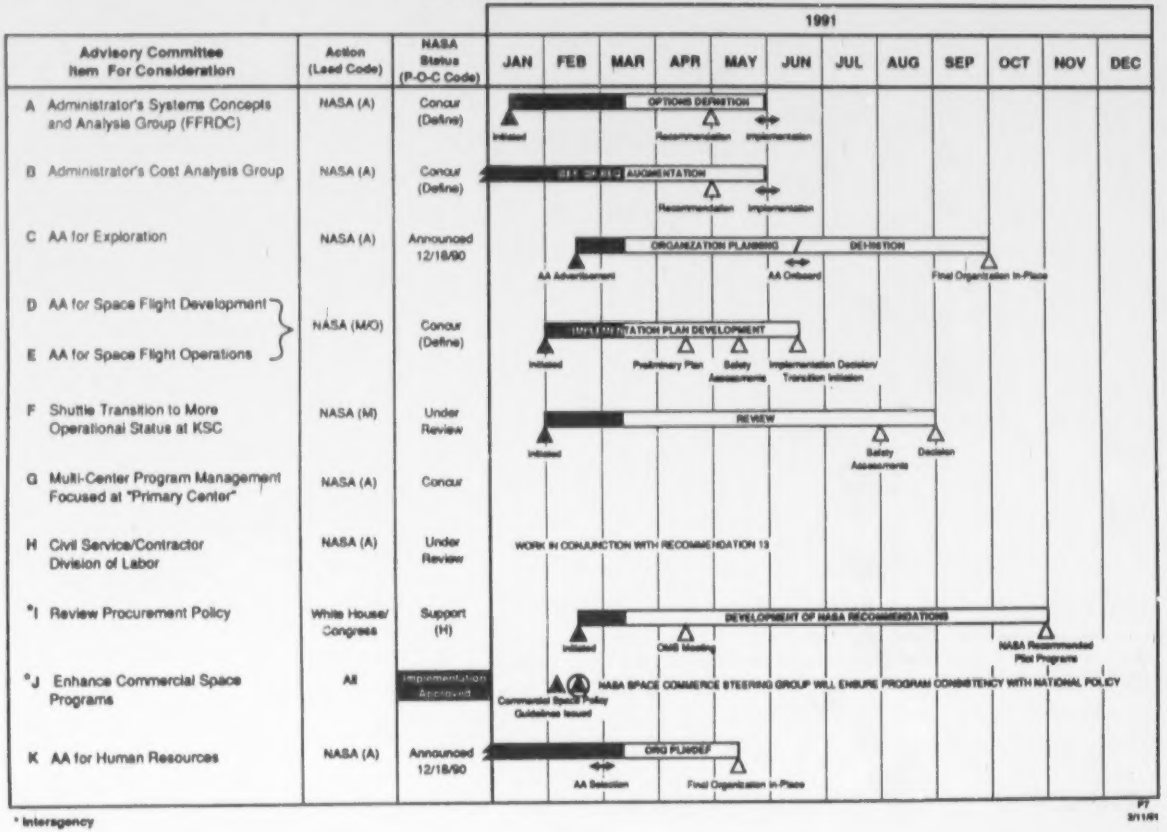
Advisory Committee Recommendation	Action (Lead Code)	NASA Status (P-O-C Code)
*14. OPM Identify NASA as Pathfinding Agency for Personnel Management		
A. Pay for Performance	OPM	Support/ Concur (N)
B. Flexibility in Senior Executive Management	NASA (N)	Concur (Define)
C. Relocation Reimbursement	NASA (N)	Concur (Define)
D. Extended TDY Costs	NASA (N)	Concur (Define)
*15. Expand/Fully Utilize Flexible Personnel Authorities		
A. Dual Comp Waivers	NASA (N)	Concur (Define)
B. Allocate NASA "World Class" Positions	OMB	Support/ Concur (N)
C. Use 425 Space Act Excepted Positions	NASA (N)	Concur (Define)
IF REQUIRED:		
D. Legislation for 10% Critical Skills Appointments	OPM/ Congress	—
IF ALL ABOVE FAILS:		
E. Phase Additional NASA Centers to FFRDC's	—	—



* Interagency

THE ADVISORY COMMITTEE ON THE FUTURE OF THE U.S. SPACE PROGRAM

NASA ACTION PLAN

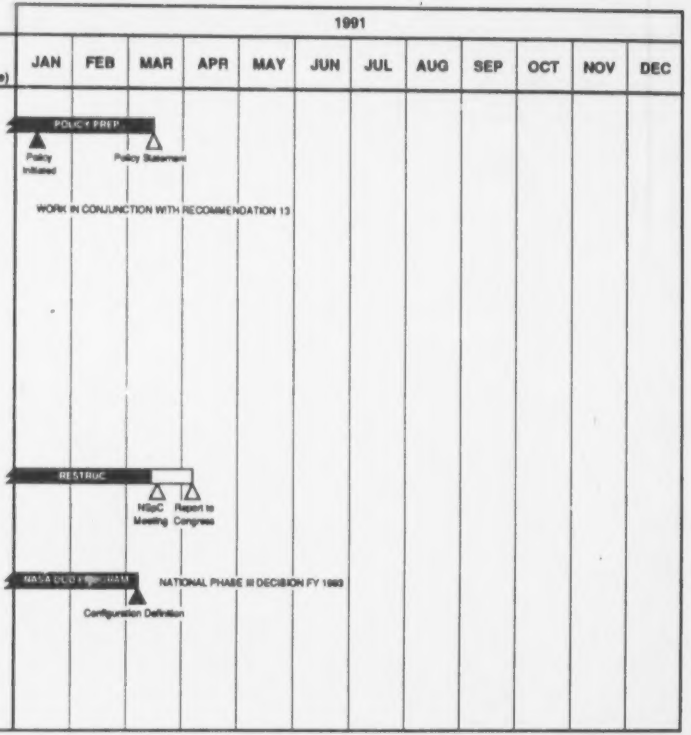


* Interagency

THE ADVISORY COMMITTEE ON THE FUTURE OF THE U.S. SPACE PROGRAM

NASA ACTION PLAN

Advisory Committee Emphasized Text	Action (Lead Code)	NASA Status (P-O-C Code)
1 Emphasize and Provide Continuity of Research Support Activities	NASA (S)	Concur
2 Increase Use of Universities as "Prime" Contractors for Research Instruments and Projects	NASA (A)	Under Review
*3 OSTP Review of MTPE Decision Process	White House	— — (S)
*4 Assess Feasibility of Commercial Operator for Environment and Land Satellites	White House	— — (S)
5 Space Station Continue as Initial Building Block of Manned Exploration Program	NASA (M)	Concur
*6 Move NASP Forward to X-Vehicle Flight Program	White House	Support (R)
*7 NASA Continue as Nation's Principal Agent for Civil Space	White House	Support (A)



* Interagency

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independent efforts, NASA and the National Space Development Agency of Japan, NASDA, will work together on nine experiments.

QUESTION 3a:

One of the criticisms of U.S. cooperative activities in space in the past has been that we were "unreliable partners".

What priority do you attach to meeting funding and schedule commitments for joint U.S.-foreign space projects?

ANSWER 3a:

We are, of course, conscious of the foreign policy significance that international projects may have. International cooperation has been an important dimension of the NASA space program from its inception. NASA has entered into well over 1200 agreements with more than 135 countries and international organizations. These relationships have covered a broad spectrum of collaborative endeavors, ranging from the development of major space hardware to the sharing of space data among scientists around the globe. Nearly every NASA project contains some element of international cooperation, except those with national security implications or near-term commercial potential. Cooperation is based on mutual programmatic interest, and international projects compete equally with domestic projects on the basis of scientific and technical merit. NASA looks at the scientific and technical benefit of the project, and in each project strives to meet the funding and schedule commitments which have been agreed on. International projects receive the same priority in funding and schedule commitments as NASA-only projects.

QUESTION 3b:

In the event of a budgetary or schedule squeeze, would you give precedence to an agreed-upon international project over a U.S.-only project?

ANSWER 3b:

In every project that NASA undertakes there is the possibility that budgetary and/or schedule problems can arise. In that event, NASA would first try schedule changes or a scientific reassessment and program revision. In extremely rare instances, a project might be cancelled because of budgetary or schedule constraints.

In international projects, each side agrees to use its best efforts to undertake certain responsibilities, and each side's ability to carry out these responsibilities is understood to be subject to its respective funding availability. If problems arise on either side, they are discussed openly, and a decision is made by both sides as to what actions are necessary.

Just as NASA strives to meet its own budgets and schedules, the agency also does its utmost to uphold international commitments,

and discusses any problems with its international partners. International projects would not take precedence over U.S.-only projects, but instead would be given equal consideration.

QUESTION 3c:

What criteria do you think NASA should use in deciding whether or not to undertake joint space missions or activities with other nations?

ANSWER 3c:

NASA's guidelines for international space cooperation are straightforward. They are designed to support the scientific and programmatic priorities of NASA, and offer clear programmatic benefit to both sides, to assure fair and equitable terms for participants, and to avoid unwarranted technology transfer. We approach all projects first and foremost from the basis of mutual interest and benefit. Each partner in a project must have a scientific and technical interest in and commitment to the effort. Each partner is fully responsible, technically and financially, for a clearly defined element of the project. The interfaces are structured so that each partner can protect its sensitive technology. Finally, the scientific results of cooperation are made available to the world community through publications in journals and presentations at conferences, and are deposited in data archives.

QUESTION 4:

How would you rate the relative priority and benefits of improving existing launch vehicles (e.g., Delta, Atlas, Titan)

ANSWER 4:

NASA currently places a higher priority on developing a new heavy-lift launch vehicle (HLLV) than improving existing launch vehicles. However, this is only because the current launch vehicles can meet the near-term mission requirements and development of an HLLV needs to be initiated soon to satisfy longer-term requirements. We view a HLLV as complementary, not competitive, to existing launch vehicles. The nation needs a family of launch vehicles. The nation needs a family of launch vehicles from Pegasus to HLLV. Moreover, the ELV family of vehicles should be continuously upgraded to maintain their reliability, robustness, and performance to meet both U.S. civil and defense requirements, and to be competitive commercially.

The HLLV is proposed to meet a set of requirements that are beyond the capability of existing launch vehicles, including support for Space Station Freedom's growth beyond its initial configuration and satisfying the heavy-lift capability required for new space exploration initiatives. NASA and DOD are currently working to define a New Launch System (NLS) with a performance range of 50,000 to 160,000 pounds to low-Earth orbit. The lower end of this range satisfies DOD requirements, which include having an alternative (or replacement) for Titan-IV,

while the upper range provides NASA a heavy-lift capability. The Advisory Committee on the Future of the U.S. Space Program (Augustine Committee), the National Space Council, and others have recommended the development of a heavy-lift launch vehicle. We believe the proposed joint NASA/DOD effort to develop NLS is a sound approach to satisfy these recommendations and increase the robustness needed in the national launch architecture. Ongoing and planned technology developments for NLS will offer the potential for improvements in the cost and reliability of existing launch vehicles.

QUESTION 5:

Please evaluate the benefits of and impediments to the re-initiation of the Saturn-V program. Identify any cost assumptions made in your analysis.

ANSWER 5:

Consideration has been given to rebuilding the Saturn V as an option for meeting heavy-lift launch vehicle (HLLV) requirements. The most attractive feature of Saturn V is its large lift capability, up to 260,000 pounds to low-Earth orbit. However, to fully utilize this capability would mean combining several missions/payloads into one flight. With the high cost of today's payloads, this means placing "a lot of eggs in one basket." The original cost of the Saturn V and its launch/operations infrastructure was approximately $16 billion in FY 1991 dollars. Our estimate to rebuild Saturn V is approximately $12-13 billion (FY 1991 dollars) which includes required design updates, modern avionics, refurbishment of existing engines, new tooling, manufacturing/test/launch facilities, and establishment/ verification of the necessary vendor infrastructure. Average cost per flight would be in the $700 - $800 million range for the first ten flights, which does not met the Agency's desired goal of operational efficiency for its heavy-lift vehicle. Furthermore, Saturn V does not satisfy DOD requirements, so NASA would have to fund the total cost. For approximately the same developmental cost, the proposed joint NASA/DOD New Launch System (NLS) could be built, with an operational cost goal of $130-140 million, which meets the requirements of both agencies.

Responses to written questions submitted by Cong. Nagle resulting from the February 7, 1991, hearing.

QUESTION 1:

Please describe for us the progress NASA has made in complying with the recommendation of the Aerospace Safety Advisory Panel that the auxiliary power units used on the Orbiter be upgraded.

ANSWER 1:

Intensive Auxiliary Power Unit (APU) upgrades have been undertaken and are continuing. These programs will reduce the operational costs of the APU program.

The improved APU Upgrade program was started in fiscal year 1982. Improved APUs have been installed in the Endeavour, and additional field installation kits will be shipped to Kennedy Space Center (KSC) in April 1991. The primary purpose of the improvements is to eliminate the Criticality I failure of pump-to-gear box shaft seal leakage, extend system life from 40 hours to 75 hours, eliminate current 20-hour refurbishment, eliminate turbine block cracking, eliminate turbine housing cracks, and add a gas generator catalyst bed spring to eliminate voids in bed.

The APU controller is being modified to change the electronics from analog to digital. This change will eliminate 80 single-point failures and change the controller from fail safe to fail/safe/fail operational.

In 1990, the gas generator valve module exhibited a cracked "seat" which delayed the Hubble Telescope launch. A redesign to eliminate this problem is taking two paths. Path "A" reduces the loads on the tungsten carbide seat by modifying the surrounding housing. Path "B" changes the tungsten carbide "seat" to KZ70 material. Testing on Path "A" will start in April and on Path "B" later this year.

QUESTION 2:

Please describe for us the progress NASA had made in complying with the recurring recommendation of the Aerospace Safety Advisory Panel that all structural negative margins that exist in the Orbiters be eliminated through appropriate modifications to the Orbiters' structure.

ANSWER 2:

The predicted loads for the Orbiters have been an iterative process. The process is based on environmental models and flight data. The current allowable flight envelope was revised at the Design Certification Review in March 1988. The analysis used in the certification included 60,000 structural components and 30 major structural assemblies (i.e., wing, vertical tail, mid-fuselage, etc.).

The analysis results indicate that the majority of the Orbiters' structure has safety factors of 1.4 or greater. However, several structural areas fall below a factor of safety of 1.4 for certain trajectories. Constraints have been defined for these areas (wings, tail, aft fuselage, CMS pods, and wing leading edge) to ensure safety factors of 1.4 are maintained. Trajectory shaping is used to maximize launch probability (Alternate I-loads) while maintaining all Orbiter safety factors above 1.4.

The structural areas requiring constraints to maintain a safety factor above 1.4 were assessed for modification. The assessment traded cost for modification against improvement of launch probability. These areas were categorized in three ways: immediate implementation, later implementation during Orbiter Maintenance Down Period (OMDP) or the modification was not cost effective.

The following structural modifications were immediately implemented: mid-fuselage frame struts replacement, strengthened mid-fuselage hinge fittings, mid-fuselage lower panel RTV heat sink addition, added thrust structure shims, OMS Pod web and longeron strengthening, and added External Tank (ET) bolt preload.

The following structural modifications will be implemented during each vehicle's OMDP: wing truss tube replacement, and strengthening of the wing upper skin panel, wing spar web and joint and aft fuselage Orbital Maneuvering System (OMS) deck frames. Columbia is scheduled for its modifications in 1991 and Discovery and Atlantis are scheduled for 1992. The modification of the vertical tail was not cost effective, however, a safety factor of 1.4 or better is always maintained for the Orbiters' structure including the vertical tail.

QUESTION 3a:

For the past five years, this Committee, along with other organizations like the Aerospace Safety Advisory Panel, has been urging NASA to make key safety improvements in the Space Shuttle Main Engine (SSME). Can you please outline the following for us:

What specific safety improvements has NASA completed (i.e., through development, certification, and incorporation into the fleet) for the SSME in the past five years?

ANSWER 3a:

LOW PRESSURE OXYGEN TURBOPUMP (LPTOP)
THRUST BEARING LOCK-NUT SPACER

HIGH PRESSURE OXYGEN TURBOPUMP (HPOTP)
TWO LOBE TURBINE BEARING NUT
TAPERED AND NON-SCALLOPED TURBINE INTERSTAGE SEAL
THICK TURBINE CARTRIDGE AND PREBURNER ISOLATOR

INCREASED PREBURNER AND TURBINE BEARING DEADBAND
INCREASED TURBINE AND PREBURNER BEARING INTERNAL CLEARANCE

REDUCED PREBURNER BEARING PRELOAD AND ELONGATED CAGE POCKETS
PREBURNER DAMPING SEALS
TWO-PIECE DAMPER FIRST STAGE TURBINE BLADES
THRUST BEARING SPEED PORT REMOVED
IMPROVED CONTOUR TURBINE TURNAROUND DUCT
TURBINE DISCHARGE STIFFENER VANE WELD IMPROVEMENT
LONG LAND LABY SEALS
RECONTOURED AND COATED 1ST STAGE BLADE SHANK
RECONTOURED, SHOT PEENED AND COATED 2ND STAGE BLADE SHANK
DUAL PILOT LIP HOUSING
1ST STAGE TIP SEALS: ECCENTRIC GROUND, REDUCED AIRFOIL CLEARANCE
2ND STAGE TIP SEALS: REDUCED AIRFOIL CLEARANCE
CUT BACK 1ST STAGE NOZZLE INNER SHROUD
TURBINE BEARING SUPPORT: ADDED FILLET WELD MATERIAL AROUND STRUT CAN COVERS
INCREASED PUMP INLET THROAT AREA
TURBINE INTERSTAGE SEAL: INCREASED 2ND DISK TO SEAL CLEARANCE
LIFT-OFF SEAL TIGHT STACK MODIFICATIONS
SINGLE POINT MACHINED MAIN IMPELLER LABYRINTHS
SHORTENED THIN LIP BELLOWS SHIELD
HOUSING WELD ROOT SIDE INSPECTION
ENLARGED COOLANT LINER DISCHARGE ORIFICES

HIGH PRESSURE FUEL TURBOPUMP (HPFTP)
WELD MISMATCH AND WELD GEOMETRY VERIFICATION
DRY FILM LUBE ADDED TO IMPELLER BOTTOMING SURFACE TO SLINGER
1ST STAGE DISK: REVERSE BROACH FIR TREE SLOTS
1ST STAGE BLADE: SHOT PEEN FIR TREES
2ND STAGE BLADE: INCREASED RADIUS & SHOT PEEN FIR TREES

MAIN COMBUSTION CHAMBER
OUTLET ELBOW REINFORCEMENT
LINER BURST DIAPHRAGM DRAINLINE

DUCTS
LOW PRESSURE FUEL DUCT HELIUM ENCAPSULATION SYSTEM
LOW PRESSURE FUEL DUCT NICKEL CLOSE-OUT SEALANT
HIGH PRESSURE FUEL DUCT REDUCED INSTALLATION PRELOAD
NEW HIGH PRESSURE FUEL DUCT WITH ALPHA CASE LAYER REMOVED
INCREASED STRENGTH MAIN FUEL VALVE HOUSING

HYDRAULIC
ACTUATOR CLEANING
ACTUATOR VITON BYPASS VALVE SPRING GUIDES
ACTUATOR POTTED WIREWAYS
SERVOCOMPONENT FILTER RETENTION
SERVICOMPONENT COIL MODIFICATIONS
DRAINLINE ISOLATION

INSTRUMENTATION
MODIFIED POGO DFI HARNESS
PRESSURE SENSOR MODIFIED INTERNAL CAVITY
ADDITION OF SKIN TEMPERATURE SENSORS TO ANTIFLOOD VALVE OUTLET
REDESIGN PRESSURE SENSOR TERMINAL HEADERS

IGNITER ASSEMBLY LOCKWIRE REROUTING
HEAT EXCHANGER DISCHARGE PRESSURE SENSOR HARNESS CLAMPING REVISION
IMPROVED HOT GAS TEMPERATURE SENSOR
ADDITION OF 4000Hz GIMBAL BEARING VIBRATION MONITOR
SPARK IGNITER CASE STRUCTURAL IMPROVEMENT

CONTROLLER
ADD REDUNDANT CONTACTS IN POWER SUPPLY/ADD SERVOVALVE DRIVE CURRENT MONITOR
REPLACE EDISON (W/TECHNITROL) 200 NANOSECOND DELAY LINE/INCREASE PBP DISCHARGE TEMPERATURE RANG
ADD THERMOCOUPLE INTERFACE
REPLACE BECKMAN (W/HONEYWELL) LADDER SWITCH
IMPROVE HEATER LATCH GROUND
ELIMINATE GROUND BOUNCE

FLIGHT CONTROL ACCELERATION CUT-OFF SYSTEM (FASCOS)
ADD HPOTP 45 DEGREE ACCELEROMETER MOUNT
SINGLE POINT FAILURE DESIGN MODIFICATIONS
INCREASED ACCELEROMETER INSTALLATION TORQUE

POST STS-26R
SPARK IGNITER REDESIGN
NEW BATTING FOR NOZZLE INSULATION
INCONEL ONE-PIECE OUTLET SPLITTER
THERMAL/VIBRATION ISOLATION MOUNT FOR Pc PRESSURE SENSOR
SSME GOX CONTROL VALVE CHECK VALVE RESEDIGN
HPTOP WELD STRAIN GAGES FOR FLIGHT
CORROSION INHIBITOR APPLICATION ONTO INSULATED STAINLESS FUEL DUCTS
HEX BIFURCATION FITTING VACUUM MELT MATERIAL
HIGH PRESSURE FUEL DUCT REDESIGN
THERMISTER MODIFICATIONS - HYDRAULIC ACTUATOR RVDT'S
MCC Pc REDLINE MONITOR FIX
REMOVAL OF POGO PCB PRESSURE SENSOR FROM FLIGHT ENGINES
INCREASE PROOF PRESSURE OF HELIUM PRECHARGE VALVE (HPV)
INSTALLATION OF LOW CYCLE FATIGUE ARRESTORS ON THE SSME NOZZLE AFT MANIFOLD
SEAL/RETAINER ASSY MOD. CUPWASHER ROTATION, HPOTP

QUESTION 3b:

What specific safety improvements will NASA complete for the SSME in the next five years?

ANSWER 3b:

Rocketdyne improved high pressure pumps	1991
Redesigned controller	1992
Alternate high pressure turbopumps	1993
Increased margin powerhead	1994
Single coil heat exchanger	1994
*Large throat/advanced fab main combustion chamber	1996
*Advanced fab nozzle	1996
*Advanced fab ducts	1996

*Assured Shuttle Availability (ASA) Items, dates are under review.

QUESTION 3c:

Please list all safety improvements for the SSME which have been suggested by safety engineers, advisory bodies, or others that will not be completed and incorporated within the operational fleet by 1996. What are NASA's views about, and plans for, each of these improvements?

ANSWER 3c:

The Flight Control Acceleration Cut-Off System (FASCOS) would provide shutdown capability, but system level safety would be adversely affected via potential for inadvertent shutdown of good running engines. Thus a decision was made to not fly FASCOS as an active system (red line).

All other suggestions have been incorporated in the engine improvement plan, subject to adequate funding for ASA items.

ANSWER 3d:

When will NASA incorporate the wide-diameter throat design into the inventory of operational SSMEs?

ANSWER 3d:

The large throat main combustion chamber is planned to be incorporated in the SSME as part of the ASA program.

QUESTION 3e:

Given the almost universal acceptance of the major safety improvement that would be realized through the use of the wide-diameter throat design, why has the Agency been so slow in incorporating this design into operational engines?

ANSWER 3e:

The expected gains in operating environments which make the large throat main combustion chamber (MCC) attractive were believed by propulsion engineering to be potentially offset by the following: 1) loss of specific impulse; 2) incompatibility to the current oxygen low-pressure pump; and 3) potential for combustion instability.

These issues have been and are currently being addressed as necessary to the change in geometry. Additionally, the current MCC contains 58 critical welds which are equally critical and also need to be addressed and corrected. The current plan, via an ASA approved item, addresses and corrects all of the above issues and is currently in the design stage.

QUESTION 4:

Please provide for the record the preliminary Servicing and Maintenance Plan that was to be one of the products of the Integrated Systems Preliminary Design Review (ISPDR).

ANSWER 4:

The "On-Orbit Maintenance Operations Plan" that the above question refers to has not been completed primarily due to the man-power intensive nature of the restructuring assessment. The External Maintenance Solutions Team (EMST) assigned the Mission Operations Directorate (MOD) at Johnson Space Center the task of developing the On-Oribt Maintenance Operations Plan based on its findings and recommendations. When completed, the plan will reflect the restructured program. This plan will be available this summer.

QUESTION 5:

Please provide for the record Volume II (Parts 1 and 2) of the External Maintenance Task Team Final Report. Also, please identify those instances in which Work Package contractor failure rate estimates changed between the time of the preliminary Fisher-Price report of February 27, 1990, and the final report of July 1990. For each instance, please provide the basis for the revision.

ANSWER 5:

Both the original work package/contractor failure rate estimates and the audited or revised failure rate estimates are provided in Volume II of the External Maintenance Task Team (Fisher-Price) Final Report previously provided to the Committee. Variances in failure rate estimates from January to July 1990 largely reflect refinement in assumptions and improved understanding of the data used to compile projected rates. Furthermore, since completion of the EMTT exercise, the Space Station Freedom program has undergone both a preliminary design review (PDR) and a major restructuring. Resulting extravehicular activity (EVA) demands have been reduced throughout these processes. By implementing the suggestions made in the final Fisher-Price report, we succeeded, during the PDR process, in reducing EVA requirements to 400-500 hours per year. The restructuring succeeded in reducing required EVA by 50% from this PDR baseline.

Responses to written questions submitted by Chrm. Hall.

QUESTION 1:

The OSSA Strategic Plan has, for a number of years, indicated that the science to be conducted with the Space Station attached payloads was important and part of the "core" OSSA research program. Now the attached payloads have been deleted from the Space Station program. In testimony before the Subcommittee on February 28th (page 48, line 1133 of the transcript), you testified that "attached payloads, for the most part, can just as easily be done on free-flyers, and we will accomplish those in some other way in the program."

a. Which attached payloads do you intend to transfer to free-flyers, and when would they fly?

b. If any of the attached payloads will not be transferred to free-flyers, please indicate how experiments will be accommodated.

c. How much money will be provided in FY 91 for alternative accommodation of attached payload experiments?

d. How much has been requested in FY 92 for alternative accommodation of attached payload experiments? How much do you anticipate would be needed in FY 93 and FY 94?

ANSWER 1:

We are exploring the feasibility of other opportunities for various attached payloads. The two EOS attached payload instruments, Clouds and Earth's Radiant Energy Systems (CERES) and Lightning Imaging-Sensor (LIS), which were to fly on Space Station Freedom, have been selected to fly on the EOS-A1 spacecraft. The Stratospheric Aerosol and Gas Experiment (SAGE III) attached payload, and six concept studies; Tropical Regions Imaging Spectrometer (TRIS N/T), Laser Atmospheric Wind Sounder (LAWS), Advanced Scatterometer for Studies in Meteorology and Oceanography (SCANSCAT), Tropical Rain Mapping Radar (TRAMAR), High Resolution Microwave Spectrometer Sounder (HIMSS), Global Positioning System Geoscience Instrument (GGI), previously selected for potential flight on Space Station are being assessed for flight opportunities on polar orbiting EOS spacecraft or other free flyers. Consistent with the President's FY 1992 budget, the EOS spacecraft will be launched in the 1998 - 2011 time frame.

b. We are assessing the resources available for attached payloads offered by the Space Station utilization ports on the truss, which may enable us to accommodate some of the attached payloads selected.

c. Approximately $700K is provided in FY 1991 for attached payload experiments. These funds are devoted to honoring NASA's commitments to graduate and undergraduate students associated with the principal investigators.

An additional $600K has been allocated for a free flyer feasibility assessment on Astromag for WIZARD (Measurement of Cosmic Ray Particles) and LISA (Large Isotope Spectrometer for Astromag).

d. The Office of Space Science and Applications budget for FY 1992 includes no specific attached payload funding. The FY 1993 and FY 1994 funding for alternative accommodations of attached payloads is currently under study.

QUESTION 2:

Advances in microtechnology would seem to allow the development of multiple "mini-rovers" for unmanned lunar or planetary missions in place of a single large rover mission.

a. Are you actively pursuing the application of that microtechnology to the design of new science missions? If so, what specific activities do you have underway?

b. How much have you requested in FY 1992 for application of microtechnology to the design of new science missions?

ANSWER 2a:

The strict size and mass constraints placed on planetary exploration missions makes the application of small, low weight components (in the form of microtechnology) highly desirable for these missions. Mission concepts that would utilize such microtechnologies are being studied for the exploration of Mars. Small landers, micro-rovers, and micro-Mars ascent vehicles (for sample return) are currently under study. Although these studies are concentrated on Mars exploration, these technologies will be applicable to the application of other solar system bodies.

NASA, through its Office of Aeronautics, Exploration, and Technology, is also funding advanced technologies for mini-rovers within its rover program, with $148K budgeted for this work in FY 1991. Activities underway include the construction and operation of engineering breadboards and a testbed model.

b. While funding levels for FY 1992 have not yet been firmly established, it is expected that the level in FY 1992 will be about the same as in FY 1991 (i.e. about $100K).

QUESTION 3:

OSSA is funding the development of several pieces of hardware for materials process experiments on Spacelab. Will it be possible to fly this equipment on the Space Station, or will new hardware have to be developed? Please explain.

ANSWER 3:

NASA plans to fly Spacelab equipment on Space Station. In order to do so, we will develop interface hardware including: generic

interface adapters, some mission peculiar equipment, rack-to-rack interconnect capability and rework of cabling. Spacelab payloads that may be transitioned to Space Station, include the Crystal Growth Furnace (CGF) and Advanced Protein Crystal Growth (APCG).

QUESTION 4:

Has NASA developed specific requirements for Landsat data for use by global change researchers? How many new and archived TM images are required annually? How many archived MSS images are required annually? [assume that the price of the data is not an issue].....and.....

QUESTION 6:

What are NASA's plans for incorporating new and archived TM and MSS data from Landsat into EOSDIS as recommended by the National Research Council?

ANSWER 4&6:

NASA agrees with the National Research Council (NRC) assessment of the importance of both past and future Landsat data as part of the data set for global change research. NASA is working with the U.S.Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), which manages the Landsat system, and the Earth Observation Satellite Company (EOSAT), which operates the system under contract to NOAA, to facilitate the most complete access for researchers to Landsat data permitted by current law. NASA intends to establish a Pathfinder data activity to process the Multi-Spectral Scanner (MSS) data recently released by EOSAT for research use. We are beginning an assessment of the scope of processing required for the MSS data, which includes the entire MSS data set except for the last two years, and of the resources needed to include this data in the EOS Data and Information System (EOSDIS). In addition, recent meetings between NASA and EOSAT officials explored other issues related to future research availability of Landsat data. Follow-on meetings have been scheduled in the coming months to continue this dialogue.

NASA believes the most effective research approach would be to make all Landsat data available to research users at the marginal cost of reproduction, perhaps through the EROS Data Center, operated by USGS, which has been designated as a Distributed Active Archive Center within the EOSDIS. This would insure the widest availability of data to Earth science researchers and would expand the number of investigations using Landsat data.

QUESTION 5:

What are NASA's current plans for including data from other Earth observation satellites (e.g., weather satellites, Earth Probes, foreign Earth observation satellites) in the operational version of EOSDIS (not just Version 0)? Have these plans changed in the last few months? Are these plans reflected in the requirements for EOSDIS?

Answer 5:

Our knowledge of the Earth will increase substantially over the next several years with the flight of a variety of U.S.and foreign research and operational missions, along with continued in-situ and ground-based observations and research. These missions include flights of NASA spacecraft, such as the Upper Atmosphere Research Satellite, Shuttle spacelabs and instruments, NOAA operational satellites, joint missions (such as the U.S./French Ocean Topography Experiment, or TOPEX/POSEIDON), and foreign missions (such as the European Remote Sensing Satellite, or ERS-1).

Our current design plan for the EOSDIS is intended to make optimum use of the data from these upcoming missions. NASA is designing the Version 0 (prototype) EOSDIS to allow researchers as much access as possible to the data from these missions and to important data from past missions. NASA has completed an agreement with NOAA and other agencies on efforts to work with Pathfinder data sets to ensure that existing data sets are identified and converted to a readily accessible form, and that new long term derived products needed for global change research are produced and made available through EOSDIS. Science panels (atmosphere, oceans and land) have already been formed to guide the implementation of an Advanced Very High Resolution Radiometer (AVHRR) pathfinder data set; data processing began in early 1991. Other Pathfinder Data Sets include the TIROS-N Operational Vertical Sounder (TOVS) and the Special Sensor Microwave/Imager (SSM/I) in the Defense Meteorological Satellite Program (DMSP).

The Version 1 (operational) EOSDIS will operate as the Earth science and applications discipline data system for NASA. Requirements for the system are designed to support open access to all existing Earth science data sets for which NASA has responsibility, as well as those other key data sets which have been included in NASA data holdings, to support their adequate availability for global change research use. This includes the provision by EOSDIS of delivery, for scientific research purposes, of the data being generated by on-going and planned NASA flight missions, such as those described above. We are negotiating agreements with other agencies, such as the National Oceanic and Atmospheric Administration (NOAA) and the U.S.Geological Survey (USGS), to ensure that their data holdings can be accessed through the EOSDIS. The EROS Data Center, which contains significant archives of land observations data and is operated by USGS, has been selected as one of the Distributed Active Archive Centers (DAACs) for EOSDIS, and its is likely that one or more existing NOAA data centers will be Affiliated Data Centers for EOSDIS.

NASA is negotiating with other nations to ensure the broadest possible data availability to support global change research. For example, we have concluded agreements which will enable the Alaska Synthetic Aperture Radar (SAR) Facility, which will also serve as an EOSDIS Distributed Active Archive Center, to archive and process important SAR data from near-term foreign missions,

such as the ERS-1 scheduled for launch later this year. NASA is also working through the Earth Observations International Coordination Working Group (EO-ICWG) toward formal agreements that would ensure that data from the EOS partners spacecraft (European Space Agency, Japan, Canada, U.S.) would be available through a common data policy to all users. Whether or not the data physically resides in an EOSDIS facility, EOSDIS users will be able to access directory and inventory information about data from other platforms and to place orders and receive data through EOSDIS regardless of who provided the instrument and on which spacecraft it flies.

NASA's general plans for the evolutionary development and capabilities of the EOSDIS have not changed significantly in the last year. Based on the specifications for EOSDIS capabilities generated by the design studies and the scientific community, NASA developed a Request for Information (RFI), released in October 1990, which produced nearly 200 comments and suggestions from industry. EOSDIS Project officials are currently incorporating these comments as they prepare the Request for Proposal (RFP) for the EOSDIS Core System (ECS) contract, scheduled for release in July 1991. This RFP will offer the opportunity for companies interested in developing the EOSDIS to submit proposals to NASA. Release of the RFP in July should enable NASA to issue a formal contract award in late 1992, with the possibility of an informal letter contract several months earlier.

QUESTION 7:

What are NASA's plans to implement the Augustine Committee's recommendation that NASA "re-establish research and development in support of environmental satellites to meet NOAA-stated requirements?" Why can't advanced land remote sensing R&D be included in this program given the studies commissioned by NOAA which detail what sensor improvements are needed?

ANSWER 7:

NASA has a long-term working relationship with NOAA which has led to the development of many successful space ventures. NASA developed the technology and spacecraft for the Landsat series and then transferred operational management of the program to NOAA in 1984. Subsequently, NASA contributed to the technology planning in support of the Landsat-6 satellite, planned for launch in 1992. NASA continues to provide, through agreement with NOAA, technical support and development of the polar and geostationary meteorological satellites (NOAA and GOES series). In addition, there was strong NOAA participation and consideration in the design of the instruments which are candidates for flight on Earth Observing System (EOS) spacecraft as well as those of Europe and Japan.

While NASA believes that its current relationship with NOAA is a productive one, we concur in the Augustine Panel recommendation that the relationship be reviewed in light of the evolving nature of the two agencies programs. In cooperation with NOAA, we have

formed a joint working group to establish a process for coordinating future cooperation. This working group will meet through the spring and summer, and may result in the drafting of a new Memorandum of Understanding between the two agencies.

In addition, NASA is conducting extensive advanced sensor technology development efforts in support of the EOS mission. This includes development of the Airborne Visible/Infrared Imaging Spectrometer (AVRIS) which will fly on research aircraft and demonstrate technology and data reduction methods needed for later development of the High Resolution Imaging Spectrometer (HIRIS). These efforts also include development of technology for the Moderate Resolution Imaging Spectrometer (MODIS) instruments, which have been confirmed for flight on the first EOS-A spacecraft. Both of these instruments, along with others in the EOS program, have land-imaging capabilities. Several of the confirmed and candidate EOS instruments have the potential to fly as operational instruments on subsequent NOAA satellites. One example is the Atmospheric Infrared Sounder (AIRS) instrument, which is designed to meet NOAA's requirements for a high- resolution infrared sounder to fly on future operational weather satellites. Moreover, some of the technology developed for EOS sensors could be applicable to the development of advanced sensors for future Landsat missions.

Responses to written questions submitted by Cong. Mineta.

QUESTION 1:

Please describe how NASA's Space Station Freedom restructuring plan will correspond to the life sciences recommendations contained in the Augustine committee report recommendations, which placed highest priority on life sciences research for the Space Station.

ANSWER 1:

The Augustine Committee recommendation for life sciences is as follows:

> "...fundamental uncertainties remain with respect to the feasibility of long duration human space flight, uncertainties that revolve around the effects of solar flares, muscle deterioration due to weightlessness, the loss of calcium in human bone structure, and the impact of galactic cosmic radiation. These basic issues need to be resolved before undertaking vast projects entailing long-duration operations involving humans in space. We thus arrive at what we believe is the fundamental reason for building a space station: to gain the much needed life sciences information and experience in long duration space operations. Such information is vital if America is not to abdicate its role in manned space flight."

Taking into consideration the Augustine Committee recommendations and the restructuring of Space Station, the space life sciences has developed a research strategy for the utilization of Space Station Freedom. It is an evolutionary process of facility development and phased deployment, with a build-up of a core, on-orbit capability over a 5-year period (1996-2001). Each phase builds upon the preceding infrastructure, enhancing the capability to perform research to meet a wider range of science requirements. Each phase also takes advantage of the unique capabilities and attributes provided by an evolving Space Station Freedom.

Key features of this evolutionary approach are:

- an integrated suite of laboratory equipment designed to perform the majority of analytical capabilities common on earth-based laboratories.

- provision of a variable-force centrifuge of the largest feasible diameter to provide on-orbit controls and exposure to the full range of the gravity variable. For the first time, the study of significant numbers and variety of experimental specimens, with appropriate controls and real-time analytical capabilities that support on-orbit replication over an extended period of the subject's lifespan, will be possible. Freedom will provide the means to acquire basic scientific research that will both

contribute to a core science knowledge base, as well as provide a proper foundation for enabling extended-duration exploration missions.

QUESTION 2:

The life sciences research community has long stated a strong requirement for a 14.7 psi atmospheric pressure level on the Space Station to enable them to do research.

a. Will the restructured Space Station have a 14.7 psi pressure level?

b. If so, at what point in the assembly sequence (date and flight number) will the 14.7 psi level be provided?

ANSWER 2a:

The institution and continuous provision of a 14.7 psi atmosphere, considered essential for the implementation of a robust experimental program in the space life sciences, will be provided by the Space Station program.

b. The continuous provision of a 14.7 psi will occur by permanently manned capability (PMC), to be achieved in FY 2000 on flight number MB-17.

QUESTION 3:

Regarding the proposed life sciences centrifuge on the Space Station:

a. Is a life sciences centrifuge baselined on the restructured Station? If so, what size?

b. When will the centrifuge be operational? How does this compare to the operational date under the previous baseline?

c. Where will the centrifuge be located and where will the animal holding facilities be located?

ANSWER 3a:

Letter from Director, Space Station Freedom (Mr. Kohrs), April 5, 1991: "The Space Station baseline is to accommodate a 2.5 meter diameter centrifuge in a node. The schedule to accomplish this should be such, that the centrifuge can be integrated on the ground into the accommodation and placed on-orbit by the first assembly flight following PMC."

b. The centrifuge is currently scheduled to be deployed on the first assembly flight, MB-18, following PMC (FY 2000). After a period of initial engineering test and check-out, the centrifuge is planned to become operational in late 2000. Under the previous baseline, the centrifuge was to be deployed in Node 2 assembly flight MB-8 in November 1996.

c. Current planning calls for the centrifuge to be located in a Node. Specific accommodation locations are being reviewed to ensure maximum centrifuge diameter with co-location of the life science microgravity holding facilities.

QUESTION 4:

Regarding the Lifesat program:

a. What are the objectives and schedule of the Lifesat program?

b. If SEI deferred to the distant future are there still reasons to proceed with Lifesat now?

ANSWER 4a:

Lifesat is an unmanned reusable satellite designed to carry out a multitude of small biological specimens to and from special orbits to understand how biological systems respond to weightlessness and to complex space radiation environment. This understanding will: 1) quantify the radiation risk to humans in space, leading to the development of effective countermeasures; and, 2) resolve fundamental questions regarding the contribution of gravity to the form and function of living systems on Earth. Currently the Lifesat program calls for four launches. Two of those launches, tentatively scheduled for 1997, and 1998, would deploy two satellites into low inclination orbits at one time. The other launches, tentatively scheduled for 1996 and 1998, would deploy single satellites into polar (high inclination) orbits. Only two Lifesat capsules will be built. Schedules are contingent on funding stability.

b. Yes. Lifesat was studied in 1986 as a gravitational and radiation biology program to provide access to space as well as to specific orbits. At that time 40% of the proposed work for Lifesat was radiation oriented and the remainder general biology. Because of SEI, the planned emphasis, over its four launches is about 70% radiation biology. The gravitational and general work is still required because of the expected synergism with radiation. If SEI were deferred there remains strong scientific justification and interest to understand space radiation effects on living matter (as well as gravitational).

Responses to written questions submitted by Cong. Torricelli.

QUESTION 1:

The subcommittee looks forward to NASA's continued progress in carrying out the Earth Observing System (EOS) program. Can you comment on NASA's progress in initiating the ground segment of EOS, called the Earth Observing System Data and Information System?

ANSWER 1:

The EOS Data and Information System (EOSDIS) effort is based on the development and delivery of a series of increasingly sophisticated and complete data system capabilities to the science user communities, in which each successive system version will be more complex, have more capability, and reach more users. The first major EOSDIS development product will be the Version 0, a basic prototype system connecting a set of distributed science users to specific existing data systems and selected new data sets to test system design and integration and to support early research efforts. The Version 0 system will be implemented by NASA, a series of Distributed Active Archive Centers (DAACs), and the EOS science investigators, with ongoing review and advice from the Science Advisory Panel and DAAC science advisory groups.

The EOSDIS Version 0 development effort will continue until completion of a transition of Version 0 data services to the Version 1, whose primary new component is the first major EOSDIS Core System (ECS) delivery. The ECS will be developed by industry and will include the hardware, software, engineering and operations required to implement the following EOSDIS functions: 1) archival and distribution of all NASA Earth science data acquired through 2002; 2) product generation at EOSDIS Distributed Active Archive Centers (DAACs) of all standard data products generated from the EOS-A1 spacecraft; 3) information management services for all EOSDIS holdings; 4) EOSDIS mission/science network to interconnect all EOSDIS facilities, elements of the science community, and international data systems, in support of product generation; and 5) command and control of the EOS-A1 spacecraft and payload (prototype system in Version 1; operational system in Version 2) except for those functions provided by NASA's Office of Space Operations, and not including the JPL and foreign partner instrument control facilities.

Requirements for the system are designed to support open access to all existing Earth science data sets for which NASA has responsibility, as well as those other key data sets which have been included in NASA data holdings, to support their adequate availability for global change research use. This includes the provision by EOSDIS of delivery, for scientific research purposes, of the data being generated by on-going and planned NASA flight missions. Version 1 will also provide a prototyping environment for development of the command and control and eventual EOS data processing that will begin with the first EOS-A launch. Version 2 will provide the capacity and full capability

for EOSDIS to serve as the data system for the first EOS-A mission, including command and control functions and full data product production along with expanded capacity for distribution of the data.

NASA has made significant progress in the development of the prototype EOSDIS. A series of EOSDIS Project and DAAC meetings were held in 1990 to develop and adopt the approach to be taken to implement Version 0. These meetings focused on the design and implementation of the Version 0 prototype information management capability that will provide users with an overall view of the data available from the various DAAC systems. EOSDIS officials contributed to final preparations for the Alaska Synthetic Aperture Radar (SAR) Facility (ASF) which, through several international agreements, will archive and process important SAR data from foreign spacecraft such as the European Remote Sensing Satellite (ERS-1). The ASF will also serve as one of the Distributed Active Archive Centers for the EOSDIS.

NASA also completed an agreement with NOAA on efforts to work with Pathfinder data sets to ensure that existing data sets are identified and converted to a readily accessible form, and that new long term derived products needed for global change research are produced and made available through EOSDIS. Science panels (atmosphere, oceans, land, and calibration) have already been formed to guide the implementation of an Advanced Very High Resolution Radiometer (AVHRR) pathfinder data set; data processing began is now underway. Other Pathfinder Data Sets include the TIROS-N Operational Vertical Sounder (TOVS), the Special Sensor Microwave/Imager (SSM/I) in the Defense Meteorological Satellite Program (DMSP), and the Multi-Spectral Scanner (MSS) data from Landsat.

Since beginning development of the Version 0 in early 1991, EOSDIS has assumed responsibility for all existing NASA Earth science data holdings, except those in the National Space Science Data Center (NSSDC); NSSDC data will gradually be transferred to EOSDIS as part of Version 1 activities. EOSDIS is providing funding for initial system computing purchases by EOS science investigators, which is the first step in developing the science processing capability. Initial results from a recent assessment of the current capability to connect all EOS Investigators (both individuals and institutions) is promising and network planning is underway. In addition, NASA is working with each of the DAAC's to form science advisory panels. Current and planned Version 0 development activities are designed to support on-line Version 0 capability by late 1994.

NASA has also made extensive progress in defining the design of the EOSDIS Core System, the primary component of the Version 1 EOSDIS. Based on specifications from definition studies and requirements from the scientific community, NASA developed a Request for Information (RFI), released in October 1990, which produced nearly 200 comments and suggestions from industry. EOSDIS Project officials are currently incorporating these comments as they prepare the Request for Proposal (RFP) for the EOSDIS Core System (ECS) contract, scheduled for release in July

1991. This RFP will offer the opportunity for companies interested in developing the EOSDIS to submit proposals to NASA. Release of the RFP in July should enable NASA to issue a letter contract in July 1992 with a formal contract award a few months later. This schedule would lead to an operational Version 1 system by 1996, and to an operational Version 2 system about a year before launch of the first EOS-A spacecraft.

QUESTION 2:

The FY 1992 funding request for EOS is as follows:

Earth Observing System:	
Instruments	159.9M
Observatory	58.5
Science	35.0
EOSDIS	82.6
TOTAL	336.0

Can you provide the long term budget run-out for EOS and its elements?

ANSWER 2:

FY 1991 funding for the Earth Observing System (EOS) totals $191 million, with a request for FY 1992 of $336 million. The following table outlines the current planned spending (in real year dollars) for EOS in FY 1991, FY 1992, and totals through FY 2000 provided in the Office of Space Science and Applications.

	Current FY 1991	Request FY 1992	TOTAL Thru FY 2000
EOS Development (a)	139.0	218.4	9100-10500
EOSDIS/Science (b)	52.0	117.6	5800- 6300
MO&DA (c)	0.0	0.0	1100- 1200
TOTAL	191.0	336.0	16000-18000

(a) Includes funding for Instruments and Observatory development activities
(b) Includes funding for Science activities (including the EOS Interdisciplinary Investigators) and the EOS Data and Information System (EOSDIS) (including the development of the Version 0 prototype system and early support for Distributed Active Archive Centers, DAACs)
(c) Includes funding for Mission Operations and Data Analysis (MO&DA) activities

Responses to written questions submitted by Chrm. Hall.

The Subcommittee is concerned that NASA is not giving adequate consideration to procuring ATDRS on a fixed-price basis.

QUESTION 1:

By the time you issue a contract for ATDRS, will the requirements for this satellite be well defined? Is NASA likely to want to make changes in the middle of the development program?

ANSWER 1:

The requirements will be well defined before NASA issues the RFP. While NASA does not expect to make changes after the contract is signed, possible changes to improve reliability and performance can never be ruled out.

QUESTION 2:

Is ATDRSS technically risky, and if so why is NASA buying a technically risk satellite for operational use?

ANSWER 2:

There is no risk in the use of current technology to support the ATDRSS mission. Risk occurs in initiating the manufacturing processes and associated control to produce space qualified hardware on the needed production schedule. This risk is inherent in any new spacecraft production.

QUESTION 3:

If ATDRSS will be well-defined and not too technically risky, why doesn't NASA buy ATDRSS like the Navy is procuring its UHF Follow-On Satellites or like a commercial buyer would--with a fixed-price contract instead of the usual cost-plus contract?

ANSWER 3:]

NASA has not yet determined how it will procure the ATDRSS. A fixed-price contract is one of the options under serious consideration. However, in order to maintain contract stability, a fixed price contract will require multiyear authorization and appropriation. The Navy contract is being examined as a potential model for this procurement.

QUESTION 4:

What would be the advantages and disadvantages of buying the first ATDRS on a cost-plus basis and buying additional copies on a fixed-price basis?

ANSWER 4:

This option is also under consideration. This type of contract

provides the government an opportunity to procure the development portion, which contains the greatest risk, under cost-plus where government intervention is easiest and to get subsequent deliveries with a controlled fixed-price, which forces contractor efficiencies. Unfortunately, during the present TDRSS program, we found serious development problems, which required changes after the launch of the first TDRSS. The real challenge is to find a mechanism to give the government the ability to ensure reliability while operating in a fixed-price environment.

Responses to written questions submitted by Cong. Torricelli.

QUESTION 1:

Can you describe NASA's timing for initiating the Advanced Tracking and Data Relay Satellite System (ATDRSS) program?

ANSWER 1:

The plan is to get a contract award in the latter part of 1992 with a first ATDRSS delivery in early 1997, which is the projected need date for replenishment of the baseline three-TDRSS constellation.

Responses to written questions submitted by Cong. Slaughter resulting from the March 6, 1991, hearing.

QUESTION 1:

As I am sure you are aware, the Commonwealth of Virginia has actively sought a leading role in the space community and the private space industry. Towards that end, I support the continued operation of the Space Station Freedom Program Office located in Reston, Virginia.

I would appreciate knowing your intentions or future plans for the Space Station Freedom Program Office in Reston, Virginia.

ANSWER 1:

The NASA Reston Office will not close. However, the amount of Space Station work that will continue to be conducted at this office is under review and will likely decrease. One of the key factors in this decision is the difficulty of doing systems engineering and integration of a complex program far from the work package centers without a large, resident engineering department.

Now that our Space Station restructuring assessment is complete, we are examining all options and their potential impacts on the Space Station program, the Fairfax County community, and the NASA employees and contractors in Reston.

NASA
National Aeronautics and
Space Administration

Washington, D.C.
20546

Reply to Attn of: L:MPK:ss

April 9, 1991

The Honorable Ralph M. Hall
Committee on Science,
Space and Technology
House of Representatives
Washington, DC 20515

Dear Mr. Hall:

After my review of the transcript from the March 6, 1991, hearing of the Committee on Science, Technology and Space on space transportation issues, I feel it is necessary to clarify the record concerning NASA's activities in support of the expendable launch vehicle (ELV) industry and the need to license launches of certain NASA payloads utilizing commercial launch services. Testimony at the March 6 hearing described NASA's recent practices in this area as a "step backward." We are in serious disagreement with this conclusion and are concerned and confused by this perception. The enclosed detailed description of our acquisition practices in this area reflects what we believe is a truly commercial approach to procuring launch services.

For the record, I would note first that NASA is actively and enthusiastically adhering to Title II of the FY 1991 NASA Authorization Act (Public Law 101-611) concerning the procurement of launch services in a commercially reasonable manner. We recently selected the Orbital Sciences Corporation to provide a series of launch services utilizing a new, totally commercial small ELV. This procurement marked the latest step in the evolution from prior governmental practice and marked the greatest use to date of commercial procurement methods by any governmental purchaser of launch services. The procurement methods used were developed in a continuing dialogue with the commercial launch industry including three industry-wide symposia at which all aspects of NASA's new procurement approach were discussed. Major aspects of the procurement which were modified to meet the needs of the industry were:

(1) use of fixed price contracts;

(2) no requirement of certified cost and pricing data submission with the proposal;

(3) work breakdown structures and cost proposals in the contractor's own formats;

(4) advance payments based on milestones;

(5) performance specifications;

(6) reciprocal liquidated damages;

(7) limits on inspection clauses; and,

(8) limited approval rights.

The sum of these changes shows that NASA is in the forefront of the Government's effort to increase reliance on commercial launch services providers. The proof of our seriousness in these procurement changes is that we selected a new launch vehicle with extremely limited flight experience to provide launch services to our smaller payloads. Further, the move away from a long established vehicle contractor proves that we, in fact, are willing and able to base major decisions on information from a new, commercial company's own management and accounting systems, without imposition of burdensome Government record or reporting systems.

We have not, however, stopped with this new procurement approach. In another innovative action, we have just signed another contract with Orbital Sciences to provide oceanographic data under the Seawifs program. In order to perform this contract, Orbital Sciences will have to launch a contractor provided spacecraft on its own commercial launch vehicle without any direct involvement by NASA. Both of these procurements were done in a commercially reasonable manner, and a commercial ELV service was procured by NASA or a NASA affiliate or provided in support of a NASA contract. The differences between the two procurements did not occur by chance, but were the result of a detailed analysis of the program needs and application of a philosophy that the level of NASA involvement in a given launch would depend on launch specific considerations. In short, NASA is acting in full accord with the underlying philosophy of the Uniform Commercial Code, i.e., that a contract is an agreement between a willing seller and a knowledgeable buyer. We know of no better measure of a "commercially reasonable" procurement practice.

Concerning the issue of licensing, last year NASA and the Department of Transportation (DOT) asked the Department of Justice (DOJ) to resolve an honest difference of opinion as to whether or not a DOT launch license was required for certain launches of Government payloads by a contractor. The case in point was the Combined Radiation and Release Effects Satellite (CRRES) mission which launched a Department of Defense (DOD) payload using the services of a commercially-procured Atlas under NASA supervision. DOJ decided that DOT's authority did not

extend to launches of NASA payloads when NASA remained substantially involved in the launch process. As a result of a ruling on this issue by the DOJ, DOT recently removed five NASA payloads from the DOT manifest of launches licensed by the Department. This does not mean, however, that NASA is not procuring commercial launch services. We are buying commercial launch services and our involvement in each of these launches is the minimum necessary to assure mission success for some unique and very costly payloads, and to insure that the taxpayers' investment is protected.

NASA's involvement in the launch process also makes it possible for NASA to ensure public health and safety and compliance with international and legal requirements and to insure that the contractor has a single point of contact within the U.S. Government. Those features of the CRRES contract were found significant by the DOJ and helped them to conclude that the purposes of the Commercial Space Launch Act (CSLA) would be frustrated, not helped, by requiring a DOT license for the specified launches. In all respects, however, the launch services acquired for NASA's major missions are commercial in nature and fully consistent with spirit and intent of Public Law 101-611 and the CSLA.

NASA and DOD are in total agreement that the DOJ ruling is correct and consistent with the intent of the CSLA. We also agree that in cases where the agencies procure on-orbit services, such as in the case of NASA's Seawifs program, the launch services would require a DOT license because substantial agency involvement is not intended. The identification of which launches require launch licenses is done on a case-by-case basis and must be done by the only agency able to determine the appropriate level of agency involvement in a given launch--the agency with programmatic responsibility and accountability for the launch. There also are other cases where the nature of the payload does not require NASA control and direction. These, too, will be subject to DOT licensing. The enclosed chart depicts NASA's planned ELV usage over the next few years and highlights these different situations; that is, NASA's licensable and non-licensable commercial ELV activities. As shown by the enclosed exchange of correspondence between NASA and DOT, both agencies now agree that the information on the ELV usage chart accurately reflects the coverage of the CSLA.

In summary, we believe the agency has taken great strides during the last year to promote commercial space activities and to comply with Title II of Public Law 101-611 and the CSLA. NASA feels it is vital to distinguish between good, commercially reasonable procurement practice, and a possible need to obtain a CSLA launch license. We feel NASA is on the cutting edge of commercial practice in the area of launch services and that it is

clearly inaccurate to portray our activities as a "step backward" for the commercial launch industry because certain of our Government launch activities do not require a DOT license. I would appreciate an opportunity to discuss this matter with you.

Sincerely,

Martin P. Kress

Martin P. Kress
Assistant Administrator
for Legislative Affairs

Enclosure

NASA

National Aeronautics and
Space Administration

Washington, D.C.
20546

Reply to Attn of: G

March 7, 1991

Mr. C. Dean McGrath, Jr.
Acting General Counsel
Department of Transportation
400 7th Street, SW
Washington, DC 20590

Dear Mr. McGrath:

Following up on my letter to you of February 4, 1991, and our meeting of February 27, 1991, I wanted to give you more detail on the approval and insight rights that NASA has determined to be necessary to fulfill its responsibility for mission success and safety. These rights flow from provisions in our contracts for commercial launch services and equal or exceed those that were cited by the Department of Justice Office of Legal Counsel (OLC) as determinative of NASA's "substantial involvement" in the launch process--a level of involvement sufficient to exempt the launch from the provisions of the Commercial Space Launch Act (CSLA) pursuant to CSLA section 21(c).

As stated in my February 4, 1991, letter to you, NASA has analyzed its usage of expendable launch vehicles (ELV's) in support of its programs in light of the OLC decision. That analysis, which was contained in the enclosure to my letter, reveals five categories of usage. Another copy of the ELV usage chart is included as Enclosure 1. The two categories listed first on the enclosure involve government-owned launch vehicles and are exempt from CSLA coverage. The last two listed categories fall within CSLA coverage and require launch licenses. The OLC opinion was focused on the remaining category of launches--the launches specified on the ELV usage chart as "Government Launches Utilizing Commercial Launch Services." All launches in this last category meet the criteria for exemption established in the OLC opinion.

The NASA contracts for those missions include terms and conditions which provide NASA with substantial approval and insight rights which NASA has determined necessary to fulfill its programmatic and fiduciary responsibilities. A summary of these retained rights is provided for your information (Enclosure 2). Since the OLC opinion held that a subset of the

listed approval and insight rights was sufficient to exempt the CRRES launch from CSLA coverage, NASA's position is that the other launches listed in this category of ELV use are also exempt from the CSLA. If, in the future, NASA determines that a specific mission's programmatic objectives can be accomplished with a level of NASA approval/insight rights substantially different from those summarized in Enclosure 2 or those specified in the OLC opinion, we will discuss those changes with your office to determine what, if any, impact those changes have on the applicability of section 21(c) to that launch.

With this common understanding of the status of the NASA launches listed on Enclosure 1, I hope we can finally resolve any issues over CSLA coverage and speak with one voice to the industry whose success we both wish. I would appreciate your written response as soon as possible.

Sincerely,

Edward A. Frankle
General Counsel

2 Enclosures

NASA ELV USAGE

	CY 1990	CY 1991	CY 1992	CY 1993	CY 1994	CY 1995
GOVERNMENT LAUNCH UTILIZING NASA LAUNCH VEHICLES • SCOUT	MACSAT 5/9/90	PROFILE	SAMPEX			
GOVERNMENT LAUNCH UTILIZING USAF LAUNCH VEHICLES • ATLAS-E (A) • DELTA-II (D-II) • TITAN II / IV (T-II / IV)	ROSAT / D-II 6/1/90	EUVE / D-II NOAA-D / A NOAA-I / A		NOAA-J / A	NOAA-K / T-II	CASSINI / T-IV
GOVERNMENT LAUNCH UTILIZING COMMERCIAL LAUNCH SERVICES • SELV - TBD (S) • DELTA II (D) • ATLAS I / IIAS (AI / IIAS)	CRRES / AI 7/25/90		GEOTAIL / D WIND / D MO / T-III GOES-I / AI GOES-J / AI	TOMS / S POLAR / D	FAST / S RADARSAT / D	SWAS / S LIFESAT - I/D SOHO / AIIAS GOES-K / AI TDRS-G / TBD
LAUNCHES SUPPORTING CENTERS FOR COMMERCIAL DEVELOPMENT OF SPACE (REQUIRES CSLA LICENSE) • STARFIRE I (SI) • PROSPECTOR (P) • CONESTOGA (C)	CONSORT-3/SI 5/16/90	CONSORT-4/SI JOUST-1 / P JOUST-2 / P	CONSORT-5/TBD JOUST-3 / P COMET-1 / C*	CONSORT-6/TBD JOUST-4 / P COMET-2 / C*	CONSORT-7/TBD JOUST-5 / P COMET-3 / C*	CONSORT-8/TBD JOUST-6 / TBD COMET-4 / C*
LAUNCHES TO PROVIDE ON-ORBIT SERVICES (REQUIRES CSLA LICENSE)				SEAWIFS / TBD		

*NASA PLANNING PURPOSES

Enclosure 1

ML-91-3-1

NASA LAUNCH SERVICES APPROVAL / INSIGHT

US GOVERNMENT SIGNATURE / APPROVAL	US GOVERNMENT INSIGHT
MISSION INTEGRATION	
• SPACECRAFT TO LAUNCH VEHICLE INTERFACE CONTROL DOCUMENTS (ICD) / DRAWINGS • DECISIONS / RESOLUTIONS OF ACTION ITEMS FROM USG / CONTRACTOR CO-CHAIRED MISSION INTEGRATION WORKING GROUPS • MISSION PECULIAR HARDWARE DESIGN, ANALYSIS, MANUFACTURE AND TEST • MISSION PECULIAR SOFTWARE DESIGN, ANALYSIS AND TEST	
PRODUCTION	
• INSPECTION, TEST AND ACCEPTANCE REQUIREMENTS* • SYSTEMS EFFECTIVENESS PLAN (SR&QA) AND CHANGES*	• PRODUCTION PROGRAM REVIEW • PRODUCTION MRB REVIEWS • FLIGHT HARDWARE PEDIGREE REVIEWS • SR&QA COMPLIANCE AND SPOT AUDITS • PRE-SHIP REVIEW (VEHICLE SPECIFIC) • DESIGN REVIEWS • QUALIFICATION REVIEWS • MAJOR / CRITICAL PROBLEMS
INTEGRATED SYSTEMS TESTS	
• TEST PLAN, REQUIREMENTS AND SUCCESS CRITERIA* • SYSTEMS EFFECTIVENESS PLAN (SR&QA) AND CHANGES*	• MAJOR SYSTEMS TEST (VEHICLE SPECIFIC) • SYSTEM TEST MRB REVIEWS • POST-TEST DATA REVIEWS (VEHICLE SPECIFIC) • ANOMALY RESOLUTIONS • FAILURE ANALYSIS • MAJOR / CRITICAL PROBLEMS

* BASELINE IN LAUNCH SERVICES CONTRACT

Enclosure 2

ML-91-8-5 2/26/91

NASA LAUNCH SERVICES APPROVAL / INSIGHT
(CONTINUED)

US GOVERNMENT SIGNATURE / APPROVAL	US GOVERNMENT INSIGHT
LAUNCH VEHICLE ASSEMBLY AND TEST	
• TEST PLAN, REQUIREMENTS AND SUCCESS CRITERIA* • SYSTEMS EFFECTIVENESS PLAN (SR&QA) AND CHANGES*	• LAUNCH SITE SUPPORT REVIEWS • VEHICLE WALKDOWN INSPECTION • SR&QA COMPLIANCE AND SPOT AUDITS • REVIEW OF OPS & PROCEDURE DISCIPLINE • REVIEW OF WORK PRACTICE / DOCUMENTATION • POST-TEST DATA REVIEWS • ANOMALY RESOLUTIONS • FAILURE ANALYSIS • WORK SCHEDULES / PLANS • VEHICLE LAUNCH COMMIT CRITERIA • VEHICLE FLIGHT READINESS REVIEW
INTEGRATED SPACECRAFT / VEHICLE OPERATIONS AND LAUNCH	
• INTEGRATED MISSION READINESS REVIEW (CHAIR) • INTEGRATED VEHICLE / SPACECRAFT ASSY & TEST PROCEDURE • INTEGRATED LAUNCH COMMIT CRITERIA • SPACECRAFT GO / NO-GO • LAUNCH CONCUR / NON-CONCUR	• MAJOR INTEGRATED SYSTEMS TESTS • ANOMALY RESOLUTION • FAILURE ANALYSIS
POST-FLIGHT MISSION ANALYSIS	
• DETERMINATION OF MISSION SUCCESS	• FLIGHT VEHICLE DATA REVIEW • TRACKING AND RANGE DATA REVIEW • ANOMALY INVESTIGATION / CLOSEOUT REVIEW

* BASELINE IN LAUNCH SERVICES CONTRACT

ML-91-8-6 2/26/91

U.S. Department of Transportation

General Counsel

400 Seventh St., S.W.
Washington, D.C. 20590

March 7, 1991

Mr. Edward A. Frankle
General Counsel
National Aeronautics and Space
Administration
Washington, D.C. 20546

Dear Mr. Frankle:

Thank you for your recent letter clarifying the National Aeronautics and Space Administration's (NASA) position concerning expendable launch vehicle launches exempt from the licensing requirement of the Commercial Space Launch Act. I am confident that we have now formulated a consistent Executive Branch position on application of section 21(c) of the Act.

The opinion rendered by the Department of Justice Office of Legal Counsel (OLC) very clearly states that the licensing requirement shall not apply to launches where the government is so substantially involved that it is effectively directing or controlling the launch. OLC noted that "substantial involvement" is demonstrated by reference to specific clauses in the launch procurement contract that provide for NASA's close supervision, both through approval requirements and ongoing insight (and/or oversight), and NASA indemnification of third party losses. While we understand that all these contractual provisions (except for NASA's agreement to indemnify) are standard to NASA contracts with private firms for launch services, the question whether any particular launch satisfies the "substantial involvement" test remains necessarily a launch-specific inquiry.

In order to provide launch-specific guidance, you have provided us with an outline of certain features of NASA's launch services procurements that represent contractual approval and insight rights that NASA has determined are necessary to fulfill its programmatic responsibilities. We agree that, consistent with the OLC opinion, the existence of these "retained rights" with respect to any particular launch demonstrates or translates into substantial involvement amounting to control of that launch such that it is "carried out by the United States on behalf of the United States." We understand that these "retained rights" are

present in all of the launches included in the third category of government launches identified on the "NASA ELV Usage" chart enclosed with your letter and, therefore, are exempt from the licensing requirement under section 21(c) of the Act. We also agree that it would be appropriate for the Department and NASA to continue to confer if NASA's level of involvement is substantially different from that represented in the aforementioned outline or from that specified in the OLC opinion.

Based on the these understandings, we will proceed to amend the current Commercial Launch Manifest to delete the following launches: Mars Observer, GOES I, GOES J, GOES K and SOHO.

While questions concerning the applicability of the Department's licensing authority to certain launches may continue to be raised, I hope we can continue to work together to ensure that consistent guidance is provided to the industry as well as to others committed to its success.

Sincerely,

C. Dean McGrath, Jr.
Acting General Counsel

STATEMENT OF

HOWARD D. TRUDEAU
VICE PRESIDENT
ADVANCED LINES OF BUSINESS
LOCKHEED MISSILES AND SPACE COMPANY
MISSILE SYSTEM DIVISION

TO THE
SUBCOMMITTEE ON SPACE, SCIENCE & APPLICATIONS OF THE
COMMITTEE ON SCIENCE, SPACE & TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

30 NOVEMBER 1990

Mr. Chairman:

It is a pleasure for me to be able to respond to your invitation to submit written testimony to your public hearing regarding the issues affecting the commercial expendable launch vehicle industry. We are grateful to be able to express our views on certain domestic issues confronting this evolving industry. Our comments will address issues pertinent to the providers of launcher systems and services primarily to government user agencies. We will focus on NASA's small expendable launch vehicle programs and on DOD requirements for access to space using similarly capable launcher systems.

The most fundamental issue confronting the space industry is embodied in the question, "What launch system can be used in the most cost effective and safe way?" The remainder of our testimony addresses this question. The concept we suggest be considered by this Committee is the use of excess military assets in a strategy encompassing the idea of converting those assets to peaceful purposes. Some background comments are in order at this point.

The Navy is in the process of retiring its POSEIDON C3 Submarine Launched Ballistic Missiles (SLBM). The Air Force has also begun a similar program for its Minuteman II InterContinental Ballistic Missiles (ICBM). These actions are the result of normal force retirement and are in response to limitations set by the START negotiations. The Navy and the Air Force have indicated recently there is an excess of these SLBM/ICBM assets.

Lockheed and others have proposed converting excess assets, where feasible, from Swords into Plowshares by using elements of these launcher systems for employment as space launch vehicles. The lift capability of designs that would use these excess assets constrains their employment as small expendable launch vehicles consigned to lightweight payloads. The cost-effective and safe delivery of lightweight payloads to space is, we believe, the <u>least</u> developed system providing access to space of all U.S. space launch vehicles.

The alternative to conversion and application of the excess missile assets is disposal by destruction. However, before destruction can commence, storage of these assets is required, at significant cost to the government. Storage and destruction must be conducted in an environmentally benign manner. This amplifies the government's cost. The government can and should utilize the remaining value in their inventory of rocket assets to avoid costs of destroying them and avoid costs of developing new missile rockets for space launch industry. While both the free market value of these assets and the costs of destroying them is unclear, the government will end up paying more if it does not use them. As a consequence of these conditions, it is essential that all costs, including federal cost avoidance, be better understood.

DESTROY OR STORE:

There is a long history of using excess strategic missile assets for launch programs. When the Atlas Weapon System was depostured, the boosters were stored at Norton Air Force Base in California. Subsequently, these boosters were refurbished and used by a variety of Air Force, Army, Navy, and NASA programs both ballistic and space. Even today, Atlas E boosters are still being used, and represent a significant cost avoidance to the user.

When the Minuteman I missile was replaced by Minuteman II and Minuteman III missiles, the depostured Minuteman I found an early application as boosters for the Army Safeguard System Test Targets Program. Minuteman I subsequently became the workhorse booster for the Reentry Systems Launch Program. It should be noted that heroic efforts were taken to store the entire inventory of Minuteman I because no one could point to uses or users for them and because there were no requirements for them in the outyears. Nevertheless, the Air Force and Army were able to introduce some ingenuity into the process, and were able to find storage facilities for them. The wisdom of that effort has long been recognized.

Minuteman I assets are being used today in a variety of Department of Defense ballistic boosters, sounding rocket applications, and have also been made available for use by both large and small contractors with significant cost savings and cost avoidance to the government.

The depostured Titan II missiles have been stored, and today are also being refurbished for space launch applications, again with significant cost savings and cost avoidance.

The application of these assets in the sense of cost savings and/or cost avoidance must be emphasized. The use of the assets will always be a savings to the using service or agency, to the Department of Defense, and to taxpayers. The use of excess assets may provide the cost savings which will enable smaller programs to proceed.

The use of excess missile assets for boosters has successfully coexisted with the development and manufacture of new hardware. The Athena booster used by the Air Force, Navy, and Army in the sixties and early seventies, and the Scout booster used by NASA are examples.

This history is relevant today for the same reasons that were relevant in the sixties and seventies. As the Defense budget declines, the imperative for avoiding or reducing cost becomes even more important. Even the NASA budget takes its share of reductions as the Congress and OMB contend with the National Budget problems and priorities. The use of excess boosters represents a cost savings and cost avoidance to the government.

Our recommendation is that excess ballistic missile assets should be used for today's programs and stored for future programs.

ASSETS ARE AVAILABLE TO THE PRIVATE SECTOR:

The government should have first call on these assets, making the assets available as Government Furnished Equipment (GFE) for contractors' use on government programs. The operative precedents are the use of Minuteman I and other government booster assets that have been stored and made available as GFE. The system and procedures have worked so far, and the government should use that experience. The assets should be available to the private sector subject to a government determination that sufficient assets will be available for possible government uses.

When government assets are made available to the private sector, the immediate question that comes to mind is, "What price should be determined, and by what process?" We suggest this somewhat simplified approach.

We feel that almost any type of used equipment can be sold in the marketplace if a reasonable fair market value is established and a competitive market exists.

Fair market value should be established by the owner of the equipment, but we feel a reasonable approach could be explained by the following equation:

Fair Market Value = Purchase Price - Depreciation +/- Impending Cost

Where:

- **Purchase Price:** is simply the price paid for the last buy of the component
- **Depreciation:** is the cost of refurbishment to original or equivalent condition
- **Impending Cost:** is the owner's assessment of his cost of retention or disposal and could be plus or minus, depending on whether he believes he can recover some of his storage costs

Given the fair market price as a starting point, any qualified company can then determine if they can use the assets at this price and be competitive. The price will fluctuate depending upon the number of competitors and the economics of the programs.

COMPETITIVENESS:

It has been suggested that making these assets available promotes unfair competition. Unfair is in the eye of the beholder. The operative objective should be the lowest cost to the user, whether it is the government or a private concern. Artificially mandating higher prices serves no reasonable end, and can certainly impact government programs by either pricing them beyond the available budget, or else reducing the program scope to remain

within budget. In either case, useful program objectives are impacted.

The argument that U.S. competitiveness is adversely affected by making available excess booster assets is mere sophistry. U.S. competitiveness is not enhanced by artificial administrative constraints that raise the price to the user, whether to the government or to the private sector. The commercial space launch industry should prevail, not as an end in itself, but because it provides access to space at lower cost.

SUMMARY:

- Since the mid-sixties, excess strategic missile assets have been used by numerous government agencies and programs to reduce launch costs.
- Some programs could not have been pursued without the advantage of lower launch costs.
- The government cannot afford to **NOT** reduce its launch costs.
- Some excess missile assets should be stored, even if specific uses cannot be identified today; requirements and uses will certainly materialize in the future.
- The competitive process alone is capable of determining the lowest price.

Mr. Chairman, we appreciate the opportunity to provide our testimony on this subject, and would be glad to respond to any questions you may have, for the record.

Responses to written questions submitted by F. Sensenbrenner.

Aeroassist Flight Experiment (AFE)

QUESTION 1:

The flight test scheduled for 1996 is anticipated to last no more than ten minutes. If you have to repeat the experiment, or want to repeat it, how much additional cost would be involved?

ANSWER 1:

The goal of the Aeroassist Flight Experiment (AFE) is to demonstrate aerobraking and establish a flight data base critical for the design of future aeroassisted vehicles. AFE will permit the validation of computational fluid dynamics codes necessary for the design of these future vehicles and will test materials, and guidance and navigation techniques in the actual flight environment which cannot be adequately or fully simulated in ground tests. There are no current plans for a second flight; the one flight that we are planning will meet all the specific program requirements.

However, if there were a justifiable reason for conducting another flight, it is estimated that it would require two years to refurbish and prepare the AFE vehicle. A new Star 63 rocket motor would have to be procured and installed in the carrier vehicle followed by spacecraft processing and integration with the Shuttle at Kennedy Space Center. The new rocket motor, processing and integration costs plus any refurbishment of the spacecraft and instruments, and principal investigator support are estimated to be $40-50 million.

SP-100 Joint NASA/DOD/DOE Space Nuclear Reactor Program

QUESTION 2:

At what point will data from the ROVER and NERVA program be put to use in developing the new generation of space nuclear reactors now in development? Explain why/how it may be useful data and what its limitations are.

ANSWER 2:

As part of the FY 1992 Exploration Technology Program, NASA has requested funds to support the initiation of an advanced nuclear propulsion technology development program. ROVER and NERVA were part of an earlier nuclear rocket program which was terminated in 1972. The ROVER/NERVA data are useful immediately because of the accumulated design data that are available and the full-scale tests of the NERVA nuclear rocket engines represent an excellent checkpoint for future designs, facility considerations, and computer models to be developed in the new program. For example, about 20 reactor tests were safely conducted in the ROVER/NERVA program that provide an extensive experience base for the future development.

Since the ROVER/NERVA program ended, much has been accomplished in the way of new technologies, particularly in the area of new materials. Under the advanced nuclear propulsion program requested as part of the Exploration Technology program, we envision utilizing these newer technologies to develop an even higher performance, lighter weight nuclear rocket engine for support of the space exploration mission operations.

While the ROVER/NERVA data may be very useful to nuclear propulsion activities, it is not very applicable to space nuclear power generation, such as the SP-100 reactor development, because of different design requirements and operating conditions.

SUBCOMMITTEE MARKUP OF NASA MULTIYEAR AUTHORIZATION BILL OF 1991

WEDNESDAY, APRIL 10, 1991

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON SPACE,
Washington, DC.

The subcommittee met, pursuant to notice, at 8:12 a.m., in room 2318, Rayburn House Office Building, Hon. Ralph M. Hall (chairman of the subcommittee) presiding.

Mr. HALL. The committee will come to order.

Today, our subcommittee will meet to begin to mark up the NASA bill for fiscal year 1992. It has been the practice in the past that we are also providing budget authority for fiscal years 1993 and 1994, and for all ongoing programs.

As my colleagues know, we have tried to move quickly this year to develop a bill and bring it to the floor in order to keep our place in the budgetary process. We have had to deal with several uncertainties in taking this approach. The Space Station Restructuring Plan has been late. The formal plan for the New Launch System is still being developed. The Earth Observing System is still under review, and in addition, the report of the Stafford Group is still in preparation, I am told.

Despite these uncertainties, I think there is great merit in moving forward in order to make sure that our priorities and the viewpoints of this subcommittee and the viewpoints of those who have cared enough and given enough time to come before this subcommittee to testify, and the staff of this subcommittee who have worked long and hard to have our viewpoints on these issues considered as early in the process as possible. We made a number of changes to the Administration's request in the committee print. As always, the subcommittee would prefer to provide as much funding as possible for the program; indeed, the Administrator's request this year is, by any measure, a reasonable and moderate one and merits full consideration for full funding.

However, it is also clear that the current budgetary environment will not allow full funding of the request. We are all aware of the constraints that are going to be imposed.

Therefore, in order to bring the NASA bill into line with overall budget realities, we found it necessary to identify reductions in many areas. The net result is a bill that provides the minimum necessary to sustain what we consider to be a healthy space pro-

gram. Any further reductions would, from this point on, I believe, be counter to the best interests of the space program.

Despite the need to make these reductions, there is also a need to identify areas which require some additional funding. One of these areas is the ASRM, which has been the subject of much debate here on the subcommittee. Some believe that the ASRM—that we need it and that it is essential to the station deployment, while others have argued that it is not needed and that we should put our resources toward other safety and performance improvements. Unfortunately, the budget we received from the Administration was not exactly the best of all worlds. It contained only half of the funding needed to make the program successful, and the decision that we need to make today is either full funding or no funding. The committee print contains full funding.

There are several other program augmentations shown in the spreadsheet which are very meritorious and which can be discussed if anyone desires. Everyone is going to have a full shot at full discussion and offering up whatever amendments they have. A full explanation is contained in the draft report language.

Today we intend to complete work and to complete the markup on all portions of the bill except the Space Station and the New Launch System. These will be considered following the hearing which we will hold tomorrow. Without objection, we will proceed with the bill by section.

I hope, for anyone who has amendments—if they have amendments that extract and require funding—that they give us a source from which to take that funding within the confines of the bill itself.

I look forward to a successful conclusion to today's meeting and completion of the markup tomorrow, and I would like to turn to the ranking Republican, Mr. Sensenbrenner, for any comments he may have.

[The subcommittee print and spreadsheet plus the prepared opening statement of the chairman follows:]

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SUBCOMMITTEE PRINT

102D CONGRESS
1ST SESSION

H. R. ___

IN THE HOUSE OF REPRESENTATIVES

Mr. BROWN (for himself and Mr. WALKER) introduced the following bill; which was referred to the Committee on _____

A BILL

To authorize appropriations to the National Aeronautics and Space Administration for research and development, space flight, control, and data communications, construction of facilities, research and program management, and Inspector General, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the ``National Aeronautics and Space Administration Multiyear Authorization Act of 1991.''.

SEC. 2. FINDINGS.

Congress finds that--

(1) the report of the Advisory Committee on the Future of the United States Space Program has provided a framework within which a consensus on the goals of the space program can be developed;

(2) the budget of the National Aeronautics and Space Administration should continue to increase toward a goal of four-tenths of one percent of the Gross National Product by the year 2000;

(3) a balanced civil space science program should be funded at a level of at least 20 percent of the aggregate amount in the budget of the National Aeronautics and Space Administration for ``research and development'' and ``space flight, control, and data communications'';

(4) development of an adequate data base for life sciences in space will be greatly enhanced through closer scientific cooperation with the Soviet Union, including active use of manned Soviet space stations;

(5) the space program can make substantial contributions to health-related research and should be an

integral part of the Nation's health research and development program;

(6) Landsat data and the continuation of the Landsat system beyond Landsat 6 are essential to the Mission to Planet Earth and other long-term environmental research programs;

(7) increased use of defense-related remote sensing data and data technology by civilian agencies and the scientific community can benefit national environmental study and monitoring programs;

(8) the generation of trained scientists and engineers through educational initiatives and academic research programs outside of the National Aeronautics and Space Administration is essential to carrying out a long-term Space Exploration Initiative;

(9) policies which restrict the use of foreign launch capabilities for United States Government satellites should apply only where adequate United States launch capabilities exist;

(10) the aeronautical program contributes to the Nation's technological competitive advantage, and it has been a key factor in maintaining preeminence in aviation over many decades; and

(11) the National Aero Space Plane program can have benefits to the military and civilian aviation programs

from the new and innovative technolgies developed in propulsion systems, aerodynamics, and control systems that could be enormous, especially for high-speed aeronautical and space flight.

SEC. 3. POLICY.

It is the policy of the United States that--

(1) the Administrator of the National Aeronautics and Space Administration, in planning for national programs in environmental study and human space flight and exploration, should ensure the resiliency of the space infrastructure;

(2) a stable and balanced program of civil space science should be planned to minimize future year funding requirements in order to accommodate a steady stream of new initiatives;

(3) any new launch system undertaken or jointly undertaken by the National Aeronautics and Space Administration should be based on defined mission and program requirements or national policies established by Congress;

(4) in fulfilling the mission of the National Aeronautics and Space Administration to improve the usefulness, performance, speed, safety, and efficiency of space vehicles, the Administrator should establish a program of research and development to enhance the

competitiveness and cost effectiveness of commercial expendable launch vehicles; and

(5) the National Aeronautics and Space Administration should promote and support efforts to advance scientific understanding by conducting or otherwise providing for research on environmental problems, including global change, ozone depletion, acid precipitation, deforestation, and smog.

SEC. 4. AUTHORIZATION OF APPROPRIATIONS.

(a) AUTHORIZATIONS.--There are authorized to be appropriated to the National Aeronautics and Space Administration the following amounts:

(1) For ``research and development'', for the following programs:

(A) United States International Space Station Freedom, no funds are authorized herein unless a full report setting forth the cost, configuration, and schedule of the Space Station, and an implementation plan for the conduct of a flight test of the solar dynamic program, is submitted to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate.

(B) Space transportation capability development, $629,800,000 for fiscal year 1992, $724,800,000 for

fiscal year 1993, and $722,400,000 for fiscal year 1994.

(C) Physics and astronomy, $1,096,600,000 for fiscal year 1992, of which $6,000,000 shall be made available for carrying out scientific programs which have otherwise been eliminated from the Space Station, $1,241,400,000 for fiscal year 1993, and $1,248,500,000 for fiscal year 1994.

(D) Life sciences, $183,900,000 for fiscal year 1992, $224,000,000 for fiscal year 1993, and $246,100,000 for fiscal year 1994.

(E) Planetary exploration, $299,300,000 for fiscal year 1992, $251,900,000 for fiscal year 1993, and $263,400,000 for fiscal year 1994.

(F) Earth science and applications, $725,600,000 for fiscal year 1992, of which $5,000,000 shall be made available only for the purchase of Landsat data for global change research, and $1,000,000 shall be made available for remote sensing data conversion, $830,000,000 for fiscal year 1993, and $950,500,000 for fiscal year 1994.

(G) Materials processing in space, $115,800,000 for fiscal year 1992, $201,400,000 for fiscal year 1993, and $233,600,000 for fiscal year 1994.

(H) Communications, $39,400,000 for fiscal year

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1992, $34,700,000 for fiscal year 1993, and $31,100,000 for fiscal year 1994.

(I) Information systems, $42,000,000 for fiscal year 1992.

(J) Technology utilization, $27,000,000 for fiscal year 1992, $29,700,000 for fiscal year 1993, and $33,000,000 for fiscal year 1994.

(K) Commercial use of space, $95,000,000 for fiscal year 1992, $132,200,000 for fiscal year 1993, and $130,400,000 for fiscal year 1994.

(L) Aeronautical research and technology, $591,200,000 for fiscal year 1992, $670,500,000 for fiscal year 1993, and $716,000,000 for fiscal year 1994.

(M) Transatmospheric research and technology, $72,000,000 for fiscal year 1992, $120,000,000 for fiscal year 1993, and $145,000,000 for fiscal year 1994.

(N) Space research and technology, $324,800,000 for fiscal year 1992, $351,700,000 for fiscal year 1993, and $367,200,000 for fiscal year 1994. Of such amounts, $10,000,000 in fiscal year 1992, $30,000,000 in fiscal year 1993, and $50,000,000 in fiscal year 1994 shall be made available for carrying out a program of component technology development

directed at commercial expendable launch vehicle competitiveness.

(O) Exploration activities, $61,000,000 for fiscal year 1992, $88,000,000 for fiscal year 1993, and $102,400,000 for fiscal year 1994.

(P) Safety, reliability, and quality assurance, $33,600,000 for fiscal year 1992, $32,500,000 for fiscal year 1993, and $34,000,000 for fiscal year 1994.

(Q) University Space Science and Technology Academic Program, $64,600,000 for fiscal year 1992, $70,500,000 for fiscal year 1993, and $74,500,000 for fiscal year 1994.

(R) Tracking and data advanced systems, $22,000,000 for fiscal year 1992, $23,200,000 for fiscal year 1993, and $24,600,000 for fiscal year 1994.

(2) For ``space flight, control, and data communications'' for the following programs:

(A) Space Shuttle Production and Operational Capability, $1,358,900,000 for fiscal year 1992, of which $375,000,000 shall be made available for the Advanced Solid Rocket Motor program, $1,277,000,000 for fiscal year 1993, and $1,210,500,000 for fiscal year 1994.

(B) Space Shuttle Operations, $2,970,600,000 for fiscal year 1992, $2,968,800,000 for fiscal year 1993, and $2,897,200,000 for fiscal year 1994.

(C) Expendable Launch Vehicles and Services, $317,900,000 for fiscal year 1992, $259,000,000 for fiscal year 1993, and $309,800,000 for fiscal year 1994.

(D) Space and ground networks, communications, and data systems, $920,873,000 for fiscal year 1992, $1,066,000,000 for fiscal year 1993, and $1,077,500,000 for fiscal year 1994.

(3) For ``construction of facilities'', including land acquisition, for fiscal year 1992 as follows:

(A) Construction of Space Station Processing Facility, Kennedy Space Center, $35,000,000.

(B) Modification for Earthquake Protection, Downey/Palmdale, CA, Johnson Space Center, $4,400,000.

(C) Modifications for Safe Haven, Vehicle Assembly Building, High-Bay 2, Kennedy Space Center, $7,500,000.

(D) Rehabilitation of Crawlerway, Kennedy Space Center, $3,000,000.

(E) Restoration of Shuttle Landing Facility Shoulders, Kennedy Space Center, $4,000,000.

(F) Restoration of the High Pressure Gas Facility, Stennis Space Center, $6,500,000.

(G) Construction of Addition for Flight Training and Operations, Johnson Space Center, $13,000,000.

(H) Construction of Advanced Solid Rocket Motor Program Facilities (various locations), $100,000,000.

(I) Modernization of Industrial Area Chilled Water System, Kennedy Space Center, $4,000,000.

(J) Rehabilitation and Expansion of Communications Duct Banks, Kennedy Space Center, $1,400,000.

(K) Replace 15 KV Load Break Switches, Kennedy Space Center, $1,300,000.

(L) Repair Site Water System, White Sands Test Facility, $1,300,000.

(M) Replace Central Plant Chillers and Boiler, Johnson Space Center, $5,700,000.

(N) Modifications to X-Ray Calibration Facility (XRCF), Marshall Space Flight Center $5,200,000.

(O) Restoration and Modernization of High Voltage Distribution System, Goddard Space Flight Center, $7,000,000.

(P) Construction of Earth Observing System Data Information System Facility, Goddard Space Flight Center, $17,000,000.

(Q) Modernization of Main Electrical Substation, Jet Propulsion Laboratory, $5,500,000.

(R) Restoration of Utilities, Wallops Flight Facility, $3,500,000.

(S) Construction of Data Interface Facility, White Sands Test Facility, $4,000,000.

(T) Rehabilitation of Tracking and Data Relay Satellite System (TDRSS) Ground Terminal, White Sands Test Facility, $5,700,000.

(U) Repair of facilities at various locations, not to exceed $1,000,000 per project, $31,700,000.

(V) Rehabilitation and modification of facilities at various locations, not to exceed $1,000,000 per project, $34,800,000.

(W) Minor construction of new facilities and additions to existing facilities at various locations, not to exceed $750,000 per project, $12,900,000.

(X) Environmental compliance and restoration, $36,000,000.

(Y) Facility planning and design, not otherwise provided for, $34,000,000.

(Z) Repair and modernization of the 12-foot Pressure Wind Tunnel, Ames Research Center, $25,000,000.

BROWCA024

12

(AA) Upgrade of Outdoor Aerodynamic Research Facility, Ames Research Center, $3,300,000.

(BB) Modernization of 16-foot Transonic Tunnel, Langley Research Center $3,400,000.

(CC) Modifications to the High Pressure Air System, Langley Research Center, $11,700,000.

(DD) Rehabilitation of Central Air System, Lewis Research Center, $5,600,000.

(EE) Rehabilitation of Icing Research Tunnel, Lewis Research Center, $2,600,000.

Notwithstanding the amounts authorized in subparagraphs (A) through (EE), the total amount authorized by this paragraph shall not exceed $430,300,000.

(4) For ``research and program management'', $2,422,300,000 for fiscal year 1992.

(5) For ``Inspector General'', $14,600,000 for fiscal year 1992, $15,300,000 for fiscal year 1993, and $15,700,000 for fiscal year 1994.

(b) LIMITATIONS.--(1)(A) Notwithstanding paragraph (4), appropriations authorized under this section for ``research and development'' and ``space flight, control, and data communications'' may be used--

(i) for any items of a capital nature (other than acquisition of land) which may be required at locations other than installations of the National Aeronautics and

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Space Administration for the performance of research and development contracts; and

(ii) for grants to nonprofit institutions of higher education, or to nonprofit organizations whose primary purpose is the conducting of scientific research, for purchase or construction of additional research facilities.

Title to facilities described in clause (ii) shall be vested in the United States unless the Administrator determines that the national program of aeronautical and space activities will best be served by vesting title in any such grantee institution or organization. Each such grant shall be made under such conditions as the Administrator shall determine to be required to ensure that the United States will receive therefrom benefit adequate to justify the making of that grant.

(B) None of the appropriations authorized under this section for ``research and development'' and ``space flight, control, and data communications'' may be used in accordance with this paragraph for the construction of any facility, the estimated cost of which, including collateral equipment, exceeds $750,000, unless the Administrator has notified the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate of the nature, location, and

estimated cost of such facility.

(2) Appropriations authorized under this section for ``research and development'', for ``space flight, control, and data communications'', or for ``construction of facilities'' may remain available until expended. Appropriations authorized under this section for ``research and program management'' for maintenance and operation of facilities, and for other services, shall remain available through the next fiscal year after the fiscal year for which such amount is appropriated.

(3) Not to exceed $35,000 of appropriations authorized under this section for ``research and program management'' may be used for scientific consultations or extraordinary expenses upon the approval or authority of the Administrator, and the Administrator's determination shall be final and conclusive upon the accounting officers of the Government.

(4)(A) Except as provided in paragraph (1)(A), appropriations authorized under this section for ``research and development'', ``space flight, control, and data communications'', or ``research and program management'' may be used for the construction of new facilities and additions to, or repair, rehabilitation, or modification of existing facilities, but only if the cost of each such project, including collateral equipment, does not exceed $200,000.

(B) Except as provided in paragraph (1)(A),

appropriations authorized under this section for ``research and development'' or ``space flight, control, and data communications'' may be used for unforeseen programmatic facility project needs, but only if the cost of each such project need, including collateral equipment, does not exceed $750,000.

(C) Appropriations authorized under this section for ``research and program management'' may be used for repair, rehabilitation, or modification of existing facilities controlled by the General Services Administration, but only if the cost of each such project, including collateral equipment, does not exceed $500,000.

SEC. 5. CONSTRUCTION OF FACILITIES REPROGRAMMING.

Appropriations authorized under section 4(a)(3)(A) through (EE)--

(1) may be varied upward 10 percent, in the discretion of the Administrator or the Administrator's designee; or

(2) following a report by the Administrator or the Administrator's designee to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate on the particular circumstances, may be varied upward 25 percent to meet unusual cost variations.

The total amount of appropriations authorized under section

4(a)(3)(A) through (EE) shall not be increased as a result of actions taken under paragraphs (1) and (2) of this section.

SEC. 6. SPECIAL REPROGRAMMING AUTHORITY FOR CONSTRUCTION OF FACILITIES.

Where the Administrator determines that new developments or scientific or engineering changes in the national program of aeronautical and space activities have occurred; and that such changes require the use of additional funds for the purposes of construction, expansion, or modification of facilities at any location; and that deferral of such action until the enactment of the next authorization Act would be inconsistent with the interest of the Nation in aeronautical and space activities; the Administrator may transfer not to exceed one-half of 1 percent of the funds appropriated pursuant to section 4(a)(1) or (2) to the ``construction of facilities'' appropriation for such purposes. The Administrator may also use up to $10,000,000 of the amounts authorized under section 4(a)(3) for such purposes. The funds so made available pursuant to this section may be expended to acquire, construct, convert, rehabilitate, or install permanent or temporary public works, including land acquisition, site preparation, appurtenances, utilities, and equipment. No such funds may be obligated until a period of 30 days has passed after the Administrator or the Administrator's designee has transmitted to the Committee on

Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate a written report describing the nature of the construction, its cost, and the reasons therefor.

SEC. 7. CONSIDERATION BY COMMITTEES.

Notwithstanding any other provision of this Act--

(1) no amount appropriated pursuant to this Act may be used for any program deleted by the Congress from requests of the Administrator as originally made to either the Committee on Science, Space, and Technology of the House of Representatives or the Committee on Commerce, Science, and Transportation of the Senate;

(2) no amount appropriated pursuant to this Act may be used for any program in excess of the amount actually authorized for that particular program by section 4(a)(1), (2), and (4); and

(3) no amount appropriated pursuant to this Act may be used for any program which has not been presented by the Administrator to either such committee,

unless a period of 30 days has passed after the receipt by each such committee of notice given by the Administrator containing a full and complete statement of the action proposed to be taken and the facts and circumstances relied upon in support of such proposed action. The National

Aeronautics and Space Administration shall keep the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate fully and currently informed with respect to all activities and responsibilities within the jurisdiction of those committees. Any Federal department, agency, or independent establishment shall furnish any information requested by either committee relating to any such activity or responsibility.

SEC. 8. SMALL BUSINESS INNOVATION RESEARCH PROGRAM.

The Administrator may utilize up to 5 percent of the funds provided for the Small Business Innovation Research Program pursuant to section 4(f) of the Small Business Innovation Development Act of 1982, for program management and promotional activities.

SEC. 9. OFFICE OF FACILITIES MAINTENANCE.

The Administrator shall create an Office of Facilities Maintenance, which shall have complete authority to plan and direct facilities maintenance management for all National Aeronautics and Space Administration sites.

SEC. 10. COMMERCIAL SPACE LAUNCH ACT AMENDMENT.

Section 24 of the Commercial Space Launch Act (49 U.S.C. App. 2623) is amended by adding at the end thereof the following: ''There are authorized to be appropriated to the Secretary to carry out this Act $5,104,000 for fiscal year

1992.''.

SEC. 11. NATIONAL SPACE COUNCIL AUTHORIZATION.

(a) There are authorized to be appropriated to carry out the activities of the National Space Council established by section 501 of the National Aeronautics and Space Administration Authorization Act, Fiscal Year 1989 (42 U.S.C. 2471), $1,491,000 for fiscal year 1992, of which not more than $1,000 shall be available for official reception and representation expenses. The National Space Council shall reimburse other agencies for not less than one-half of the personnel compensation costs of individuals detailed to it.

(b) It is the sense of Congress that the National Space Council, in coordination with the Committee on Earth and Environmental Sciences, should, by October 1, 1991, establish policy recommendations for carrying out the President's commitment to maintaining the continuity of Landsat data, including plans and programs for a succesor to Landsat 6, organizational options and recommendations for acquiring Landsat data for global change research, national security, environmental management, and other governmental purposes, and options and recommendations for encouraging the use of Landsat data by commercial firms and development of the commercial market for such data.

SEC. 12. OFFICE OF SPACE COMMERCE AUTHORIZATION.

There are authorized to be appropriated to the Secretary

of Commerce for the Office of Space Commerce $491,000 for fiscal year 1992.

SEC. 13. AMENDMENT OF PUBLIC LAW 100-147.

Section 107(a) of the National Aeronautics and Space Administration Authorization Act of 1988 (P.L. 100-147) is amended--

(1) by inserting ``, in both then year and constant dollars,'' after ``estimated cost'';

(2) by inserting ``assembly (including related costs);'' after ``construction of facilities;''; and

(3) by adding at the end the following new sentence: ``Each such plan shall also include the estimated cost, in both then year and constant dollars, of operations for at least the first full year of steady operations of the space station.''.

April 9, 1991 7:38 PM

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MULTIYEAR AUTHORIZATION ACT OF 1991

REPORT

CONTENTS

Introduction.....
Purpose of the Bill.....
Legislative Reporting Requirements.....
Explanation of the Bill and Committee Views.....

[to be added]

Sectional Analysis.....
Committee Recommendations.....
Congressional Budget Office--Cost Estimate.....
Effects of Legislation on Inflation.....
Changes in Existing Law Made by the Bill as Reported.....
Oversight Findings and Recommendations.....
Oversight Findings and Recommendations of the Committee
on Government Operations.....
Administration Recommendations:
NASA Request.....
DOT Request.....

INTRODUCTION

Over the next decade, the substantive efforts of the space program will be directed toward preparing a space infrastructure to carry out major initiatives in environmental study and human exploration. This infrastructure will include a system of Earth observing platforms together with a data management system, a manned Space Station, and a space transportation system. The Committee's review of the budget request for fiscal year 1992 and succeeding years has been carried out with the intent of ensuring that this infrastructure is resilient and based on a sound long range strategy.

Concurrent with this infrastructure development, NASA intends to execute a science strategic plan made up of large, intermediate, and small missions together with programs designed to utilize and enhance man related elements of the space program. The Committee's efforts have been directed at ensuring the stability of this strategic plan in a budgetary context and its responsiveness to broader scientific needs.

The Committee's consideration of the NASA request this year has also been carried out within the framework of the Report of the Advisory Committee on the Future of the U.S. Space Program. This report has provided a strong basis for developing a consensus on the long range goals and directions for the space program. As established in this report, such a consensus does not now exist and has been lacking since the Apollo program. As a result, the underlying rationale for the space program in the present budgetary, social, and political environment has received no serious consideration in nearly two decades and space policy has largely resulted from specific hardware initiatives and budgetary influences. Thus, ambitious extensions of the space program including renewed human exploration initiatives and major environmental monitoring efforts, should rightfully be reconsidered and based on a full understanding of the contemporary role of science and technology in the National agenda.

Key to sustaining the robust and balanced space program recommended by the Advisory Committee report is a consensus on a long-range stable and increasing budget. The budgetary growth recommended by the Report, an annual increase of 10 percent real growth, will lead to a doubling of the NASA budget before the year 2000 at which time the NASA budget will reach a level of 0.4 percent of the GNP. This approximates the average share of the GNP allocated to the space program during the Apollo era.

[figure 1]

Although this specific budget growth may be difficult to sustain over a long period, the Committee believes that some such steady commitment of at least half that growth rate is essential to expanding the space program beyond its present dimensions. If such a budget

growth does not materialize and the space program remains at or near its present level, the present balance between science and infrastructure development and the long range intent of the manned program will need to be seriously reconsidered.

The Committee has provided a multiyear authorization for NASA's major programs in order to more realistically establish their budgetary requirements and has also developed guidelines in critical policy areas. A summary of major provisions of the bill is as follows:

- Funds for the Space Station and the New Launch System will be added by amendment pending a review of these programs.
- General reductions have been applied in certain Space Transportation Capability Development programs with a view of restoring these funds in future fiscal years as their needs become better defined.
- The rate of increase in funding for spacecraft definition studies and instrument development for the Advanced X-Ray Astrophysics Facility has been slowed pending clearer demonstration of success in mirror metrology.
- Funding has been provided for alternative flight programs for those attached payloads that were deleted from the Station.
- Funding has been provided for life science activities on the Soviet Mir Space Station.
- Funding has been provided for the Lifesat new start, however, program growth in fiscal years 1993 and 1994 has been slowed.
- The rate of increase in funding for the Earth Observing System has been reduced pending completion of the current technical review.
- Funding has been added for Earth probes, classified remote sensing data conversion, and the Earth science data analysis activities which were deferred in fiscal year 1991.
- Funding has been provided for the purchase of Landsat data for Global Change research.
- Funding for Materials Processing in Space has been reduced based on the need to develop alternative flight programs for deleted Station attached payloads and also the need to better define the role of Station materials processing facilities that are scheduled to be delivered after the Permanent Manned Capability milestone, when Life Science activities should predominate.
- The rate of increase in funding for Commercial Use of Space has been reduced without prejudice.
- The rate of increase in funding for Technology Utilization has been reduced.
- A program of component technology development has been established in order to assist the commercial launch vehicle industry.
- In lieu of a Flight Telerobotic Servicer program, an automation and robotics technology program has been established emphasizing teleoperated Space Station payload technologies and micro rover technologies for planetary exploration.
- A general reduction in Exploration Activities has been made without prejudice. The Committee reaffirms its strong support for a sustained Exploration program.
- Funding has been augmented for the Advanced Solid Rocket Motor

program in order to allow it to support the Space Station requirements and schedule.
- Funding has been augmented to maintain an active Shuttle structural spares and Shuttle production support program.
- Work on the "glass cockpit" within the Assured Shuttle Availability Program has been reduced.
- Funding for two future Shuttle flights has been eliminated and one Shuttle flight has been delayed.
- Overall funding for Shuttle Operations has been reduced in anticipation of greater management and program efficiencies.
- Funding for expendable launch vehicle services for MSAT has been deleted pending clearer definition of the role of the MSAT consortium.
- A general reduction has been made to the Space and Ground Networks, Communications, and Data Systems program.
- Funds from the construction of the ASRM facility have been applied to the ASRM development program.
- A general reduction has been made to the Research and Program Management account.
- The sense of Congress has been expressed that the National Space Council should develop policy recommendations for the follow-on program to Landsat 6.

PURPOSE OF THE BILL

The purpose of the bill is to authorize appropriations to the National Aeronautics and Space Administration (NASA) for fiscal years 1992, 1993, and 1994, and to the Department of Transportation Office of Commercial Space Transportation, the Department of Commerce Office of Space Commerce, and the National Space Council within the Executive Office of the President. The bill also sets forth special policy provisions and authorities in order to carry out the activities of the civil space program. In summary, the bill provides the following budget authority:

AMOUNT OF NEW BUDGET AUTHORITY
[Millions of Dollars]

	Fiscal year 1992	Fiscal Year 1993	Fiscal Year 1994
National Aeronautics and Space Administration.....	$12,195.9	$9,822.1	$9,972.4
Department of Transportation Office of Commercial Space Transportation.....	$5.1		
Department of Commerce Office of Space Commerce.....	$0.5		
National Space Council.....	$1.5		

Summary of Committee Views

POLICY

Science Budget "Bow Wave".--The Committee is concerned that the future year budget requirements and projections resulting from the science programs requested in fiscal year 1992 are so large that no budget margin or new starts will be available.

SPACE STATION

Space Station Program Restructuring.--The Committee is concerned that the proposed restructuring of the Space Station will not achieve the original goals of the program.

Program Management.--The Committee is concerned that contemplated management changes may be disruptive and costly unless a clear long range transition plan is developed.

PHYSICS AND ASTRONOMY

Advanced X-Ray Astrophysics Facility (AXAF).--The Committee reduces the rate of increase in AXAF funding.

Deletion of Space Station Attached Payloads.--The Committee regrets NASA's deletion of the attached science payloads from the Space Station program and directs NASA to develop alternative means of conducting the experiments that were deleted.

Astronomy and Astrophysics in the 1990s.--The Committee urges NASA to give serious consideration to the findings and recommendations of the National Academy of Sciences' review of astronomy and astrophysics priorities for the 1990s when the Office of Space Sciences and Applications revises its strategic plan.

LIFE SCIENCES

Lifesat.--The Committee reduces NASA's runout for the Lifesat program and urges NASA to exert strong discipline over program costs.

Cooperative Research on Mir.--The Committee supports cooperative life sciences research on the Soviet space station Mir and directs NASA to provide a plan for such cooperative activities.

PLANETARY EXPLORATION

Comet Rendezvous Asteroid Flyby (CRAF) Program.--The Committee is concerned about the turbulence in the CRAF program over the past year.

Planetary Exploration and the Proposed Office of Exploration.--The

Committee has reservations about the potential transfer of robotic missions from the OSSA to the new office of Exploration and urges the NASA Administrator to formally solicit the views of the scientific community prior to approving such a transfer.

EARTH SCIENCE AND APPLICATIONS

Earth Observing System.--In the absence of the report of the Earth Observing System (EOS) external engineering review and an affordable plan for this program, the Committee has reduced the rate of increase in funding for EOS.

EOS Data and Information System.--The Committee directs NASA to maintain the schedule for the EOSDIS procurement and continue rapid development of EOSDIS Version 0.

Landsat Data Purchase.--The Committee has made $5,000,000 available only for the purchase of Landsat data for the Global Change Research Program, with the intention that NASA and the private operator of Landsat reach a mutual agreement on an equitable and low-cost price for Landsat Thematic Mapper data. The Committee urges NASA to assist in preserving archived Landsat data and to incorporate new and archived data into the EOS Data and Information System.

Earth Probes.--The Committee has augmented the funding for Earth Probes to accelerate the development of the Tropical Rainfall Measurement Mission and to fly the Earth science attached payloads deleted from the space station.

MATERIALS PROCESSING IN SPACE

Reduction in Funding for Space Station Utilization.--The Committee believes that NASA should provide alternative flight opportunities for the physics and astronomy attached payloads that were deleted from the Space Station program.

COMMUNICATIONS

ACTS Experiments Program.--The Committee believes that NASA should maintain adequate funding for an industry experiments program using ACTS notwithstanding contemplated establishment of Centers for the Commercial Development of Space.

INFORMATION SYSTEMS

Preserving Existing Data and Handling New Data.--The Committee urges NASA to devote sufficient resources to preserving data collected over the past 30 years.

TECHNOLOGY UTILIZATION

Reduction in Rate of Funding Increase.--The Committee believes that the technology utilization program can be made more effective within a more modest budget envelope.

COMMERCIAL USE OF SPACE

Budgetary Growth Associated With Flight Programs.--The Committee reaffirms its support for programs to encourage private investment in space activities but believes that budget realities prevent the near doubling of the budget for Commercial Use of Space.

Industry Participation.--The Committee requests a report on plans to increase incentives for the Centers for the Commercial Development of Space (CCDS) to obtain industry cash support, such as a matching fund program, and plans for the periodic recompetition of CCDS contracts.

SPACE RESEARCH AND TECHNOLOGY

Research and Development Support for the Commercial Launch Vehicle Industry.--The Committee continues to urge NASA to take actions to develop and provide new technologies to the commercial launch vehicle industry.

Flight Telerobotic Servicer.--The Committee reduces the funding for the Flight Telerobotic Servicer program in the wake of the transfer of this program out of the Space Station Office.

EXPLORATION ACTIVITIES

SP-100 Reactor Program.--The Committee wishes to be kept informed as to how the exploration-related requirements of the SP-100 program are being addressed.

Synthesis Group.--The Committee notes that the Synthesis Group will be reporting on alternative approaches to human exploration. The Committee requests a report on NASA's response to the Synthesis Group's findings.

ACADEMIC PROGRAMS

Educational Goals of the Human Exporation Program.--The Committee commends the establishment of education as a primary goal of Human Exploration. The Committee believes that a focused program of secondary educational initiatives and direct university and academic programs will be necessary to provide the educated workforce necessary to carry out an aggressive Human Exploration program.

SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY

Orbiter Production Readiness.--The Committee directs NASA to move with all deliberate speed to complete a long-range plan for the Space Shuttle Orbiter production line.

SPACE SHUTTLE OPERATIONS

Cost Savings in the Space Shuttle Program.--The Committee notes the testimony of key NASA officials that significant cost savings could be achieved in the Space Shuttle program without causing a negative impact on quality or safety. The Committee expresses support for such an initiative.

EXPENDABLE LAUNCH VEHICLES AND SERVICES

Deletion of Funding for the MSAT Launch Vehicle.--Given the recent court decision effectively rescinding the license for the American Mobile Satellite Consortium (AMSC), the Committee believes that funding to pay for part of the launch vehicle for AMSC's mobile communications satellite (MSAT) would be premature and that federal agencies should procure MSAT services directly as required.

SPACE AND GROUND NETWORKS, COMMUNICATIONS, AND DATA SYSTEMS

Adequacy of Funding.--The Committee expresses its concern that delaying planned improvements of aging and inefficient equipment may result in greater long-term costs and degradation in NASA's ability to support future flight missions.

Advanced Tracking and Data Relay Satellite.--The Committee views the Advanced TDRS procurement as an opportunity to establish a more cost-effective space network and urges NASA to consider procurement on a fixed-price basis as one potential option.

LEGISLATIVE REPORTING REQUIREMENTS

Reference and Requirement

Section 4--A Life Sciences Plan for Cooperative Research on Mir. Due December 1, 1991.

Section 4--A report on NASA's response to the Findings and Recommendations of the Synthesis Group. Due six months after the release of the Synthesis Group's report.

Section 4--A report on NASA's plans for increasing incentives for Centers for the Commercial Development of Space (CCDS) to obtain industry cash support, NASA's process for reviewing the level of industry support obtained by the centers, and NASA's plans for recompeting the CCDS contracts. Due on November 1, 1991.

Section 4--A report summarizing the progress NASA is making in providing technology support to the commercial launch vehicle industry. The report is due by March 1, 1992.

Section 4--A long-range plan for how to handle the production line for Space Shuttle Orbiters. This plan was originally due to the Committee by March 1, 1990. The committee directs NASA to "move with all deliberate speed" in completing this plan.

Section 4--A report on how NASA will achieve annual cost savings of 3 to 5 percent in the Space Shuttle program. The report is due by March 1. 1992.

EXPLANATION OF THE BILL AND COMMITTEE VIEWS

SECTION 1: SHORT TITLE

Section 1 designates that the act may be cited as the "National Aeronautics and Space Administration Multiyear Authorization Act of 1991."

SECTION 2: FINDINGS

Section 2(1) finds that the report of the Advisory Committee on the Future of the U.S. Space Program, known as the "Augustine report", has provided a framework for developing a consensus on space goals.

Section 2(2) finds that the budget growth recommended by the Augustine report should continue toward the goal of 0.4 percent of the GNP, about half that of the peak funding during the Apollo program.

Section 2(3) finds that a balanced science program should be funded at 20 percent of the non-institutional budget of NASA. This is intended to maintain an overall balance between science and infrastructure development.

Section 2(4) finds that cooperation with the Soviets on the Space Station Mir may enhance the life sciences data base. This finding is based on the foreign policy benefits that may accrue and the overall cost effectiveness of utilizing existing space capabilities, especially in view of the diminishing scope of life sciences intended for the near term on the Space Station Freedom. This finding is not intended to signify any lessening of support for a strong U.S. program of permanent manned presence in space.

Section 2(5) finds that the space program can make substantial contributions to medical and health related research. The intent is to encourage an integrated plan of health research between NASA and other health related research agencies.

Section 2(6) finds that Landsat data are essential to any long term environmental research program such as Mission to Planet Earth. The Committee intends that NASA undertake efforts to integrate Landsat data into the EOS Data and Information System for use by participating researchers.

Section 2(7) finds that heretofore classified remote sensing data may be of use for environmental research programs such as Mission to Planet Earth and Global Change. The Committee intends that NASA undertake a program, in cooperation with Defense and Intelligence agencies, to study ways of utilizing such data without compromising national security.

Section 2(8) finds that the Space Exploration Initiative will depend directly on the generation of trained scientists and engineers.

The Committee believes that the successful generation of the necessary trained work force can be accomplished through a balance of societal educational initiatives at the secondary educational level, and also through directly administering related grants and contracts to colleges and universities to employ faculty and students in space exploration research.

Section 2(9) finds that policies which restrict the use of foreign launch vehicles for U.S. government satellites should only apply when adequate U.S. launch capabilities are available. The Committee recognizes that such restrictive policies are intended to provide support for a strong U.S. launch services industry. Indeed, the Committee has provided NASA ample authority in the past to restrict procurement of launch services to domestic sources. However for some satellites, such as the Earth Observing System platform A, the absence of a U.S. launch system with lift capabilities between the Atlas E and Titan IV-class vehicles from the West Coast has resulted in a program which may be overly complex and costly. The Committee strongly feels that adequate launch capabilities out of the West Coast should be established. However, if such is not possible, the intent of this finding is to encourage the seeking of waivers from any such restrictive policies if the application of such policies does not serve the public interest or result in a cost-effective scientific program.

[Technology and Competitiveness Subcommittee findings to be included]

SECTION 3: POLICY

Section 3(1) states the policy that the Administrator should ensure resiliency in the space infrastructure. The Committee intends that this policy result in multiple capabilities for access to space, especially in assembling and servicing the Space Station.

Section 3(2) states the policy that a balanced and stable science program should be planned to minimize future year funding requirements.

Committee view

Science Budget "Bow wave"

The Committee clearly recognizes the great progress that has been made in developing an overall strategic plan for carrying out a balanced space science program. This plan has provided valuable long range planning data on the decisions that can be anticipated in initiating future missions and projects. The report of the Advisory Committee on the Future of the U.S. Space program has recommended the execution of this strategic plan and, further, established a budgetary context for this plan as a 20 percent share of the overall NASA budget (normally taken to be the non-institutional budget, Research and Development, and Space Flight, Control, and Data Communications).

The Committee endorses these recommendations as a reasonable way of structuring a balanced science program that provides a steady stream of new starts. However, the Committee notes that the fiscal year 1992 request for NASA's overall science program represents an increase over FY 1991 of nearly 21 percent of which less than one percent is attributable to new starts. Furthermore, the funding required in fiscal year 1993 to carry out the programs approved in fiscal year 1992 represents an increase of 22 percent. Thus, the issue arises whether such increases can be expected in the present budgetary environment and, if not, can such a strategic plan be considered sound.

Figure 2 shows a general representation of the budgetary context implied by the Augustine report. Shown is a 20 percent allocation of the overall NASA budget for the past two fiscal years together with the next three fiscal years if the overall NASA budget grows in real terms by 10 percent per year. This can be compared to the budget actually provided in the past and requested in the future for NASA's science program exclusive of the Earth Observing System (EOS) (which is generally considered to be a "special initiative" and not included in a balanced science program). The additional funding for the Earth Observing System is also shown.

[figure 2]

As shown, if the budget continues to grow at the optimistic rate recommended by the Augustine report, NASA's fiscal year 1993 budget for the balanced science program contains virtually no margin and no planned possibility for a new start. Not until fiscal year 1994 does any margin materialize. The Committee is concerned that any failure of the NASA budget to grow at the optimistic rate will result in program stretch outs (with their attendant cost overruns), program cancellations, a malaise in new activity, and a general disruption in the science community. Science opportunities that have been promised cannot be provided.

In addition, the funding required for the special initiative, EOS, must be provided from elsewhere in the budget. NASA's multiyear budget request shows that funding for Research and Program Management and Space Flight is expected to stabilize and conceivably provide this funding wedge. Indeed, the Augustine report recommends substantial initiatives to reduce personnel overhead, Center overlap, and greater efficiencies in the Shuttle program. The Committee notes, however, that stabilizing these programs will be a challenging management task and genuine cost savings must be realized if such special initiatives as EOS are to be carried out above and beyond the balanced science program.

The Committee recommends that NASA reevaluate its strategic science plan to establish a more realistic budgetary context. Announcements of opportunity must be carefully managed and offered only if genuine and realistic opportunities exist. Finally, NASA should plan such special initiatives as EOS only if legitimate funding wedges can be developed from efficiencies elsewhere in the NASA budget.

Section 3(3) states that any major new launch system should be based on actual program requirements or policies established by Congress. The Committee's hearings have not identified any specific programmatic need for the proposed New Launch System at this time except for assembly of the Space Station. Although the Committee concurs with and endorses the recommendations of the Augustine report related to the need for a new launch system, the Committee seeks to integrate this recommendation into NASA's overall program plan.

Section 3(4) states that in fulfilling the mission of NASA as articulated in the original Space Act, the Administrator should undertake a program of research and development to enhance the competitiveness and cost effectiveness of the commercial industry. The Committee has provided funding for a component technology program for this purpose.

Section 3(5) states that a major activity of NASA should be to conduct research on pressing environmental problems such as global warming, ozone depletion, acid rain, deforestation, and smog.

SECTION 4: AUTHORIZATION OF APPROPRIATIONS

SECTION 4(a)(1)(A) SPACE STATION FREEDOM

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$2,028,900,000
1993	$2,426,000,000
1994	$2,790,800,000

Committee Recommendation:

Fiscal Year:	
1992	$
1993	$
1994	$

Committee authorization recommendation

Authorization is being withheld pending resolution of the program restructuring content and NASA's internal review of the Space Station management structure.

Program description

The Space Station program is directed toward the development of a permanently manned, 30-year research facility in low-Earth orbit. It is an International Space Station, being developed jointly by the United States, Canada, the European Space Agency, and Japan. The multi-Center program is managed by means of a Level II Space Station Program Office located in Reston, Virginia.

The Space Station program is in the process of being restructured to conform to Congressionally directed budgetary guidelines. In addition, the Space Station program management structure is being reviewed by senior NASA management.

Committee views

Space Station Program Restructuring

The Committee has been a strong and consistent supporter of the Space Station program. The Committee notes with some disappointment that over the last several years many of the original capabilities that NASA indicated would be provided for the Space Station have been deleted or deferred into the indefinite future as a result of budgetary, cost, and technical difficulties. However, the Committee believes that the original program objective of providing a robust permanent outpost in space and a utilitarian laboratory for scientific activities should remain the preeminent goal.

The Advisory Committee on the Future of the U.S. Space Program and a number of other advisory groups have stated that the primary need for the Space Station is to do life sciences experimentation and to support the development and verification of long duration space operating systems for human space flight. A permanently manned, rather than a man-tended Space Station, is required to carry out those activities. The Committee is concerned, however, that the current restructuring of the Space Station program seriously weakens the commitment to achieving a permanently manned capability.

The tentative date for achieving a permanently manned capability (PMC) has been slipped three years into the future relative to the schedule in place just 18 months ago. In addition, the levels of budgetary reserves contained in the restructured program, the apparent lack of a specific funding plan for an Assured Crew Return Vehicle (ACRV), and a continuing uncertainty over the likely costs that will be associated with the operation of the Space Station mean that there may not be sufficient resources allocated in the program to achieve PMC.

The low level of reserves to cover problems during the crucial development period FY 1991-95 means there is an uncomfortably high likelihood of further schedule slippage during that time. Such schedule slips would have a significant cost impact, given that the program will be expending funds at the rate of $200 million per month during that period.

The ACRV is critical to the achievement of a permanently manned capability, and the Committee supports its development. However, the ACRV is estimated to cost $1-2 billion to develop, and NASA had not incorporated it into the Space Station budgetary plan during the restructuring.

The Committee reiterates its long-standing concern over the potential operations costs of the Space Station. The NASA Authorization Act for FY 1988 requires that the annual budget submission after FY 1997 for the basic operation and enhancement of the Station and its associated ground systems not exceed 10 percent of the total NASA budget. Control of operations costs must be a high priority of the Space Station program. Holding operations costs down may require changes in NASA's traditional approaches to operations. Indeed, in the Committee Report accompanying the FY 1987 NASA Authorization Act, the Committee urged NASA

> to consider innovative approaches to operations cost control including institutional measures which will decrease the number of ground personnel required to operate the Station, minimize the sustaining engineering manpower, and reduce the administrative overhead, all while maintaining an adequate margin of safety.

Since the Space Station is envisioned to be a national (and international) research facility, NASA may wish to consider how other national research facilities are operated, such as the DOE laboratories, which are operated by private contractors. The Committee offers no specific recommendations to NASA at this time, but does emphasize that it will be paying close attention to NASA's approach to operations over the coming year.

The Committee continues to be concerned that the restructured Space Station design has not reduced transportation requirements for the assembly and outfitting of the Station. The number of Shuttle flights required to assemble and outfit the restructured Station to the point of PMC is approximately equal to the number required to assemble and outfit the previously baselined complete Phase 1 Station, even though the restructuring eliminated a set of solar arrays, two nodes, and other content that had been in the Phase 1 program.

The Committee again notes that many of the previously planned uses of the Space Station have been eliminated or deferred in recent years, and the Committee thus is troubled by the impact of the restructuring on the Space Station's remaining capabilities to support scientific research. The Committee urges NASA to address constructively the issues raised in the reports of the National Research Council and the NASA Advisory Council on the utilization of the Space Station for scientific experimentation.

The Committee notes with approval that the adoption of a pre-integrated truss should reduce assembly EVA and simplify the assembly task. In addition, the adoption of down-sized modules should, if they are designed and managed properly, allow greater ground-based outfitting and checkout of the modules prior to launch. The Committee commends the NASA and contractor personnel involved in the restructuring for their hard work and dedication to the task.

Program Management

Many internal and external advisory groups strongly recommended the establishment and support of an independent Space Station Level II program office. In fact, this Committee, in its 1986 report on its investigation of the Challenger accident, recommended that NASA should give special attention to moving the Shuttle program manager to NASA Headquarters

> to avoid the confusion and inter-center rivalry that result from having a large multi-center program managed out of one of the participating centers.

All of these recommendations led to the establishment of the current Level II Space Station office. Furthermore, the National Research Council's 1987 report to the White House on the Space Station program recommended that

> NASA management must emphasize that the Space Station Program Director [i.e., the head of the Level II office] is the principal line manager of the Space Station Program and is accountable for the successful development of the Space Station. He must be equipped with authority commensurate with this accountability.

and

> The Space Station Program Office [i.e., Level II] must be continually supported and reinforced by senior NASA management. There are likely to be tendencies for control of the Space Station Program to move away from the Program Office to the NASA Centers. Such diffusion of influence would be highly inappropriate for the Space Station Program.

On the other hand, the Augustine Committee report clearly recommended a revision of this approach and the focusing of program management closer to the participating NASA Centers. In addition, many have argued that the existence of an independent Washington based program office is duplicative and costly. The Committee is aware of the substantial difficulties NASA has had in attracting highly qualified personnel for the Level II office.

Furthermore, the Committee fully recognizes that different management structures may be required for each major phase of the Station program. This need must, however, be balanced against the potential costs and loss of control that may accompany disruptive management changes. The need to avoid disruptions would appear to be particularly important over at least the next year, given that, as a result of the restructuring, "delta PDRs" and a Man-Tended Phase Review will have to be conducted, Work Package responsibilities will have to adjusted, program documentation will have to be revised, and so forth. Indeed, this type of activity may well persist until the Critical Design Review.

Since previous management plans submitted to the Congress have not discussed a change in the management structure like that which appears to be contemplated, the Committee requests that NASA develop a comprehensive long range management plan for the Station including the evolution of systems engineering and integration and operations responsibilities. This plan should recommend clear program responsibilities for the remaining phases of the Station program. In addition, the report must identify the cost and schedule impacts of proposed changes to the current management approach. The Committee requests that this plan be submitted accompanying any proposed management change but not later than December 31, 1991.

SECTION 4(a)(1)(B) SPACE TRANSPORTATION CAPABILITY DEVELOPMENT

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year	
1992	$879,800,000
1993	$999,800,000
1994	$997,400,000

Committee Recommendation:

Fiscal Year:	
1992	$629,800,000
1993	$724,800,000
1994	$722,400,000

Committee authorization recommendation

Section 4(a)(1)(B) authorizes the appropriation of $629,800,000 in fiscal year 1992 for Space Transportation Capability Development activities. This represents a decrease of $75,000,000 below the President's request. This decrease reflects the combined effect of: a $20,000,000 decrease in funding for Upper Stages, deferring funding for the purchase of a Centaur upper stage pending completion of negotiations with the Defense Department; a $10,000,000 decrease in funding for Spacelab activities, deferring some hardware replacements; a $15,000,000 decrease in the

Engineering and Technical Base, reflecting a slower than planned rate of growth; a decrease of $15,000,000 in Payload Operations and Support Equipment, deferring some Space Station support; and a $15,000,000 decrease in Advanced Programs, deferring increased emphasis on a personnel transportation system.

Section 4(a)(1)(B) also authorizes the appropriation of $724,800,000 in fiscal year 1993 and $722,400,000 in fiscal year 1994 for Space Transportation Capability Development activities. Excluding the New Launch System, these ammounts are equal to the Administration's estimate.

Program description

The principal areas of activity in Space Transportation Capability Development include the operation of Spacelab flight hardware with some continuing development activities; procurement of Upper Stages required to place satellites in high altitude orbits; the Engineering and Technical Base support at the manned space flight centers; Payload Operations and Support Equipment for accommodating NASA payloads that will fly on the Space Shuttle; Advanced Programs study and evaluation efforts; Advanced Transportation Technology efforts including the Administration's request for the definition and preliminary development of a new launch vehicle capability and improved propulsion technology; and the design and development of the United States/Italian Tethered Satellite System.

SECTION 4(a)(1)(C) PHYSICS AND ASTRONOMY

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$1,140,600,000
1993	$1,321,400,000
1994	$1,308,500,000

Committee Recommendation:

Fiscal Year:	
1992	$1,096,600,000
1993	$1,241,400,000
1994	$1,248,500,000

Committee authorization recommendation

Section 4(a)(1)(C) authorizes $1,096,600,000 in fiscal year 1992, $1,241,400,000 in fiscal year 1993, and $1,248,500,000 in the fiscal year 1994 for Physics and Astronomy. Of this amount, $6,000,000 has been transferred from the Materials Processing in Space budget line to allow alternate development of experiments that were to be Space Station attached payloads. The reductions from the President's request and from the estimates for fiscal years 1993 and 1994 shall be taken from the Advanced X-Ray Astrophysics Facility (AXAF) account. The reductions slow the rate of increase in AXAF funding over the next three years to allow increased time for technical development work.

45-073 O—91——22

Program description

The objectives of the Physics and Astronomy program are to increase understanding of the origin and evolution of the universe, the fundamental laws of physics, and the formation of stars and planets. The objectives of the Physics and Astronomy program are accomplished by means of a mixture of large free-flying space missions, Explorer spacecraft, Shuttle/Spacelab flights, and suborbital missions.

The Physics and Astronomy program will continue development of the third of the Great Observatories, the Advanced X-Ray Astrophysics Facility (AXAF) in fiscal year 1992.

Work will also continue on the Global Geospace Science (GGS) mission. This mission supports an international cooperative activity, the Collaborative Solar Terrestrial Research (COSTR) project. Teams from the United States, the European Space Agency, and Japan are involved in COSTR.

The Explorer program will continue development activities on the X-ray Timing Explorer (XTE) in FY 1992. In addition, two new Explorers, the Advanced Composition Explorer (ACE) and the Far Ultraviolet Spectroscopic Explorer (FUSE), will begin development in fiscal year 1992.

Committee views

Advanced X-Ray Astrophysics Facility (AXAF)

The Committee is concerned that the Advanced X-Ray Astrophysics Facility (AXAF) program has been encountering technical difficulties in the mirror metrology activities associated with the development of the mirrors for the observatory. At the same time, the Committee recognizes that the development of the mirrors is technically very challenging. NASA indicates that the difficulties are being resolved, and the Committee hopes that this will prove to be the case. However, earlier spacecraft programs have demonstrated the programmatic risks in attempting to move too rapidly in the face of technical problems. For that reason, and because the overall budget request for space science is not sustainable, the Committee reluctantly is slowing the rate of increase of AXAF funding.

Deletion of Space Station Attached Payloads

The Committee regrets that the attached physics and astronomy payloads have been deleted from the Space Station program as a part of the restructuring. The experiments that were to have been carried out by means of the attached payloads have been a part of the Office of Space Science and Applications Strategic Plan for a number of years. Indeed, investigator teams, including a number from universities, had already been formed to implement those peer-reviewed proposals that had been approved by NASA. If the Strategic Plan's approach to setting priorities in the space science program is to have meaning, then provision should be made to provide alternative access to space for those experiments that have been part of the Strategic Plan but which have lost their originally planned payload carrier. Thus, the Committee is transferring $6,000,000 from the Space Station utilization account of the Materials Processing in Space

budget line to fund development of alternative means of conducting experiments that were to fly as attached payloads on the Space Station.

Astronomy and Astrophysics in the 1990s

The Committee notes with interest that the National Academy of Sciences (NAS) has completed a review of potential space-based and ground-based astronomical and astrophysical projects that could be undertaken in the 1990s. The NAS committee achieved a consensus on a number of recommendations to strengthen the field, both through a judicious selection of missions and through improvements to infrastructure. The Committee urges NASA to give serious consideration to the findings and recommendations of the NAS study when the Office of Space Science and Applications revises its Strategic Plan.

An important feature of the astronomy and astrophysics program of the 1990s is the provision of small payload opportunities, which NASA plans to provide through the Small Explorer (SMEX) program. The SMEX program is intended to offer low cost, flexible, and rapid access to space for small and innovative payloads. The Committee thus reacts with some concern to reports from the science community that the SMEX program as currently structured may not achieve those goals. Specifically, it is important that the paperwork and procedures associated with the SMEX program be streamlined to the maximum extent possible. In addition, flexibility should be available to experimenters in the design of missions, and rigid standardization should not be forced on disparate missions. The Committee urges NASA to work with the science community to ensure that the SMEX program is responsive to the needs of the investigators.

SECTION 4(a)(1)(D) LIFE SCIENCES

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$183,900,000
1993	$284,000,000
1994	$326,100,000

Committee Recommendation:

Fiscal Year:	
1992	$183,900,000
1993	$224,000,000
1994	$246,100,000

Committee authorization recommendation

Section 4(a)(1)(D) authorizes $183,900,000 in fiscal year 1992, $224,000,000 in fiscal year 1993, and $246,100,000 in fiscal year 1994 for Life Sciences. Of the amount authorized in fiscal year 1992, $2,000,000 is provided for cooperative life sciences research activities on the Soviet space station Mir. The reductions from the President's estimates for fiscal year 1993 and fiscal year 1994 shall be taken from the Lifesat account. The intent of the reductions is to slow the rate of increase in Lifesat funding.

Program description

The Life Sciences program is directed toward increased understanding of human responses and adaptability to the space environment. Such knowledge is essential to the success of the ambitious human activities contemplated under the Space Exploration Initiative. It also has the potential to contribute to our understanding of terrestrial diseases and medical problems. The Life Sciences program will also provide information important to the success of Space Shuttle and Space Station operations.

Several Shuttle Spacelab missions with significant levels of life science experimentation are planned for fiscal year 1992. Definition and development of an integrated Centrifuge facility for use on Space Station will continue in fiscal year 1992. Lifesat, a reusable reentry satellite for life sciences research, will be a new program initiative in fiscal year 1992. Its mission initially will focus on radiation research.

Committee views

Lifesat

The Committee has strongly supported the need for the capabilities afforded by Lifesat. In addition to fulfilling the focussed research needs in space radiation, the Committee intends that the Lifesat program will provide to the life sciences community a means for frequent, low cost flight opportunities. NASA will have to exercise strong program discipline to ensure that Lifesat's development and recurring costs are kept under control. The Committee stated in H.R. 5649, the National Aeronautics and Space Administration Multiyear Authorization Act of 1990, H. Rept. 101-763, that it intended to review NASA's performance in meeting this goal. The significant increase in Lifesat program cost estimates over the last year concerns the Committee. Therefore, the Committee is reducing its authorization for the Lifesat program in fiscal year 1993 and fiscal year 1994 below NASA's planned runout. The Committee reiterates that continued Lifesat program cost growth will not be supported, since uncontrolled cost growth in any one life sciences flight project can jeopardize the conduct of a balanced Life Sciences program.

Cooperative Research on Mir

NASA has cooperated with the Soviet life sciences research community for a number of years. The Committee supports the continuation of appropriate cooperative activities in the life sciences. To that end, the Committee is providing $2,000,000 of the fiscal year 1992 Life Sciences authorization for cooperative life sciences research activities on the Soviet space station Mir. The intent of the funding is not to support policy studies but rather to support cooperative utilization activities. The Committee directs NASA, in consultation with its Advisory Committee to provide a comprehensive plan for cooperative research activities on Mir by December 1, 1991.

SECTION 4(a)(1)(E) PLANETARY EXPLORATION

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:

1992	$627,300,000
1993	$635,300,000
1994	$643,500,000

Committee Recommendation:

Fiscal Year:

1992	$299,300,000
1993	$251,900,000
1994	$263,400,000

Committee authorization recommendation

Section 4(a)(1)(E) authorizes $299,300,000 in fiscal year 1992, $251,900,000 in fiscal year 1993, and $263,400,000 in fiscal year 1994 for Planetary Exploration. The amounts authorized in Section 4(a)(1)(E) exclude funding for the Comet Rendezvous Asteroid Flyby/Cassini (CRAF/Cassini) mission. A multiyear authorization for the CRAF/Cassini mission, not to exceed $1,600,000,000, was provided in Public Law 101-611 (Nov. 16, 1990).

Program description

The Planetary Exploration program focuses on the scientific exploration of the solar system, including the planets, their satellites, comets, asteroids, and the interplanetary medium.

In fiscal year 1992, the Mars Observer spacecraft will be launched on an expendable launch vehicle to Mars, where it will go into orbit about the planet. Its mission objectives are to map the global surface composition, atmospheric structure and circulation, topography, gravity, and magnetic fields of Mars.

Development activities will continue on the CRAF/Cassini mission. The CRAF/Cassini program was restructured in early 1991. CRAF's mission is to pass by an asteroid and rendezvous with a comet, making long-term measurements. Cassini is intended to undertake long-term observations of Saturn's atmosphere, rings, magnetic field, and moons. As part of the mission, a probe will be launched into the atmosphere of the moon Titan.

Committee views

Comet Rendezvous Asteroid Flyby (CRAF) Program

The Committee is troubled by the turbulence in the CRAF program over the past year. The Committee recognizes that the withdrawal of planned foreign participation from part of the spacecraft development effort had an adverse impact on the program plan. Nonetheless, it appears to the Committee that there was an underestimation of the technical risk associated with the program, especially with respect to the Penetrator, which has led to significant upward cost pressures. The subsequent elimination of the Penetrator has led to a marked decrease in the science content of the mission relative to the original plans. That such a dramatic descoping had

to occur so soon after the completion of the Phase B activities that should have bounded the technical and cost risks of the program prior to the initiation of Phase C/D is disturbing. The Committee will be watching the progress of this program very carefully over the coming year.

Planetary Exploration and the Proposed Office of Exploration

The Advisory Committee on the Future of the U.S. Space Program suggested that NASA consider establishing an Associate Administrator for Exploration "with responsibility for both robotic and manned exploration of the Moon and Mars." The NASA Administrator has indicated that he will establish a new Office of Exploration. To date, no decision has been announced regarding the potential transfer of robotic mission responsibility from the Office of Space Sciences and Applications (OSSA) to the new Office of Exploration.

The Committee has reservations about the wisdom of such a transfer. Robotic exploration of the Moon and Mars has long been an integral part of a balanced planetary science program and would likely remain so even in the absence of a human exploration program. There do not appear to be compelling reasons to eliminate OSSA's responsibility for such robotic missions, although there clearly should be close coordination with the Office of Exploration. The Committee would therefore encourage the NASA Administrator to formally solicit the views of the scientific community through the appropriate solar system exploration committees of the NASA Advisory Council and the National Academy of Sciences prior to any decision on where to assign the responsibility for lunar and Mars robotic missions.

SECTION 4(a)(1)(F) EARTH SCIENCE AND APPLICATIONS

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$775,600,000
1993	$1,108,000,000
1994	$1,562,500,000

Committee Recommendation:

Fiscal Year:	
1992	$725,600,000
1993	$830,000,000
1994	$950,500,000

Committee authorization recommendation

Section 4(a)(1)(F) authorizes the appropriation of $725,600,000 in fiscal year 1992 for Earth Science and Applications. This represents a reduction of $50,000,000 from the President's request, reflecting the combined effect of: a reduction of $75,000,000 in the Earth Observing System, including the EOS Data and Information System; the addition of $15,000,000 for Earth Probes; the addition of $4,000,000 for Mission Operations and Data Analysis to continue those data analysis activities deferred in fiscal year 1991 by the reprogramming of $4,000,000 for the Ocean Color Mission data purchase; the addition of $1,000,000 to for

converting data collected by classified remote sensing systems to civilian uses; and the addition of $5,000,000 only for the purchase of Landsat data for global change research. The Committee intends that NASA and the private operator of Landsat reach a mutual agreement on an equitable and low-cost price for Landsat Thematic Mapper data. Section 4(a)(1)(F) also authorizes the appropriation of $830,000,000 in fiscal year 1993 and $950,500,000 in fiscal year 1994, which represents ten percent real growth in the Earth Science and Applications budget.

Program description

The Earth Sciences program consists of the Earth Observing System (EOS), the Earth Probes, precursor missions, and Earth science. These programs constitute NASA's Mission to Planet Earth, which is the space-based data collection and analysis activity of the U.S. Global Change Research Program. NASA's programs are part of a larger international effort related to gaining a better understanding of the Earth's environment and global change phenomena.

The Earth Observing System will be a long-term effort to obtain a fifteen-year data set on atmospheric, oceanic, and geological processes and interactions, with the objective of examining critical global change phenomena and studying the Earth as a complete system. The program envisions a series of EOS-A and EOS-B spacecraft in polar orbit, each with a suite of instruments to allow simultaneous measurement of rapidly changing phenomena and intercorrection of instrument measurements. The first large platform (EOS-A) is scheduled for launch in fiscal year 1999. The Administration is currently conducting an external engineering review of the EOS program.

A key element of the EOS program is the Earth Observing System Data and Information System (EOSDIS). One of its major functions is handling the distribution, storage, and archiving of the data obtained from the EOS spacecraft. EOSDIS will also incorporate data from instruments on other U.S. and foreign Earth observation spacecraft. An indispensable complement to the EOSDIS effort is support for scientific research and data analysis activities.

Another extremely important part of the Mission to Planet Earth is the Earth Probes program. Earth Probes instruments will be flown on small and medium-sized satellites to obtain high-priority data in the near term or data which cannot be obtained by the EOS spacecraft. Precursor missions, including TOPEX/Poseidon and the Upper Atmospheric Research Satellite, will be flown in the next several years to improve our understanding of terrestrial, atmospheric, and oceanic processes. Finally, data from operational satellites, including Landsat and the environmental satellites operated by the National Oceanic and Atmospheric Administration, are essential to the Global Change Research Program.

Committee views

Earth Observing System

The Committee strongly supports the Mission to Planet Earth program

because of its potential to dramatically improve our understanding of the Earth's environment and global change phenomena, including the impact of human activities on the environment. The Committee remains very concerned that the Earth Observing System program is not sufficiently resilient with respect to future budget shortfalls. Future budget constraints may lead to smaller funding levels than required to keep the original program on schedule, especially in a program with such large future funding requirements. Already, a shortfall in the expected fiscal year 1992 budget request has forced deletion of one major instrument from the first EOS satellite, a delay in the launch of the first EOS satellite, and a delay in developing instruments for follow-on satellites. Cost overruns and technical difficulties in a program of this complexity may also cause delays and reductions in capability.

Much of the EOS program's lack of resilience can be attributed to the placement of all of the proposed instruments for EOS-A on one large platform. Not only does this lead to greater technical complexity, but all instruments and spacecraft systems must be developed in parallel leading to highly interactive schedule and cost risks.

The Advisory Committee on the Future of the U.S. Space Program found that "a combination of different size spacecraft appears to be most appropriate to meet the needs of simultaneity, accuracy, continuity, and robustness." The Committee notes that while the large platform concept addresses scientific requirements for simultaneity, these requirements are not absolute and other objectives, including continuity, program resilience and early return of data, are equally important.

As a result of the Augustine Committee's recommendation, the Administration is conducting an external engineering review of the EOS program. The results of this review will be essential for determining the future structure of the Mission to Planet Earth program. The Committee encourages this review panel to carefully examine the structure and content of the entire EOS program, including the first EOS-A satellite, and take concrete steps to make the program more resilient. The Committee recommends that the review panel consider the advantages and disadvantages of flying the EOS-A group of instruments on three or more smaller satellites. The Committee believes that while such a configuration may not be technically optimal, it would constitute a more resilient approach. If future budgets fall short of expectations, parts of the program can proceed on schedule while less urgent parts are deferred. The Committee also urges the review panel to consider the role of Landsat in the Mission to Planet Earth effort.

In the absence of the report of this external engineering review panel and an affordable plan for the EOS program, the Committee is not confident that the proposed program can be successfully funded and implemented. The Committee has reduced the Earth Observing System program by $75,000,000 in fiscal year 1992, which represents approximately half of the requested increase. The Committee expects that this can be accomplished by reducing the reserves for the EOS instruments and deferring some activities, reducing or eliminating funds for EOS-B and EOS-A follow-on studies, and reducing the level of support for internal EOSDIS activities while maintaining the current schedule for the EOSDIS procurement and continuing

to rapidly develop the EOSDIS Version 0. Alternatively, if the external engineering review so recommends, NASA could implement an option to fly the EOS-A instruments, or variants, on more than one smaller spacecraft.

The Committee has provided for ten percent real growth in the total budget for Earth Science and Applications in fiscal years 1993 and 1994, which reflects the Augustine Committee recommendation for ten percent real growth for NASA. The Committee would consider increasing the allocations for fiscal years 1993 and 1994 pending the submittal of the report of the external engineering review, as well as NASA's response, and the identification of an adequate budget "wedge" for the Earth Observing System.

The Committee notes the current lack of a U.S. launch vehicle capability with a payload capacity to polar orbits intermediate between that of the Atlas E and Titan IV launch vehicles. Establishing such a capability requires modifications and additions to the current facilities at Vandenberg Air Force Base and modifications to existing launch vehicles. The Committee recommends that NASA work with the Department of Defense (DOD) to ensure that any facilities planned by the DOD will also be available for use by NASA and any launch vehicle modifications take into account NASA's potential needs. The Committee also believes that NASA should not be restricted from using foreign launch vehicles when a similar capability is not available in the United States if such policies prevent the establishment of a resilient and cost-effective scientific program.

EOS Data and Information System

The Committee recognizes that NASA has devoted considerable attention and resources to the EOS Data and Information System (EOSDIS). The Committee views the EOSDIS as the most challenging aspect of the Mission to Planet Earth program and the key to obtaining the maximum benefits from our investment in this program. The Committee recommends that NASA maintain the schedule for the EOSDIS procurement and continue rapid development of the EOSDIS Version 0.

The Committee further recommends that NASA plan to incorporate data from other U.S. and foreign environmental satellites, both current and planned, in the operational version of EOSDIS. Use of existing data sets from other environmental satellites in prototype versions of the EOSDIS does not satisfy the need to integrate data sets from all available sources and make them accessible on a long-term basis. The Committee believes that NASA needs to work more closely with the international community to assure compatibility between the EOSDIS and data obtained from foreign Earth observation spacecraft, and reduce unnecessary duplication between U.S. and foreign programs.

Landsat Data Purchase

The Committee notes the consensus of the scientific community, as reflected in a report last year by the National Academy of Sciences, that Landsat data are sufficiently important to global change research that they should be incorporated in the EOSDIS. The Landsat data archives constitutes a two-decade record of environmental changes. Furthermore,

while data from the EOS will not be available until 1999 or later, Landsat data are available now. Even after EOS-A is launched, Landsat data will constitute a valuable complement to the data from the EOS instruments.

The Committee has made $5,000,000 available only for the purchase of Landsat data for the Global Change Research Program. The Committee intends that NASA and the private operator should reach a mutual agreement on an equitable and low-cost price for Landsat data for the Global Change Research Program.

The Committee believes that NASA and the private operator of Landsat should take full advantage of the flexibility provided by the Land Remote-Sensing Commercialization Act of 1984, Public Law 98-365, as amended, which allows the private operator of the Landsat system to provide data at reduced prices for any research and development programs if a complete disclosure of the results of the research and development is made publicly available and the data are not used for commercial purposes or in substantial competition with data available directly from the Landsat operator. The Committee notes that two-year old Landsat Multi-Sprectral Scanner data are now available at 25 percent of the nominal price, reflecting the approximate marginal cost of reproduction and distribution. The Committee expects that arrangements could be made to provide new and archived Thematic Mapper data in a like manner.

The Committee does not view this data purchase program as a long-term solution to the problem of Landsat data continuity. The Committee urges NASA to coordinate with the other agencies involved in the U.S. Global Change Research Program to make more permanent arrangements which assure the availability of Landsat data to the civilian community. The Committee recognizes that this is not an issue for NASA alone, but as the agency responsible for collecting environmental observations from space for the Global Change Research Program, NASA should take the lead within the Committee on Earth and Environmental Sciences and the National Space Council to ensure that Landsat data will be available to the global change research community. The Committee believes that taking advantage of existing capabilities such as Landsat will enhance the cost-effectiveness of the Mission to Planet Earth program and provide important data sooner. The Committee believes that the fact that Landsat has commercial as well as scientific capabilities should not deter this country from continuing a program whose dividends have been so great.

The Committee also notes with great concern the possibility that a significant fraction of Landsat imagery acquired since 1972 will be lost in coming years as storage media degrade or the original processing systems become inoperable. The Committee believes that the Landsat data archive represents the fruits of a $1.5 billion public investment in Landsat and contains incredibly valuable information on the environment. The Committee recognizes that NASA is not the agency responsible for the data archives, but urges NASA to work with other responsible agencies to ensure that this data archive is transferred to more permanent storage media and incorporated to the extent practicable into the EOS Data and Information System (EOSDIS). The Committee believes that the Land Remote Sensing Commercialization Act, as amended, provides a sufficient mechanism for providing archived Landsat data to the EOSDIS.

Earth Probes

The Committee strongly supports an aggressive Earth Probes program. The Earth Probes program, consisting of both small and medium-size spacecraft, will allow important global change phenomena to be observed and studied in the near term, including investigations which cannot be carried out by the Earth Observing System. The Committee believes that the Earth Probes program is as important to our understanding of global change phenomena as EOS. Budgetary problems which might occur in the EOS program should not be allowed to adversely impact the content or schedule of the Earth Probes program.

In order to conduct the Mission to Planet Earth as a continually evolving program, as recommended by the Augustine committee, the Committee urges NASA to maintain sufficient flexibility in its program and budget planning to respond quickly to new needs as they arise. The Committee believes that the Earth Probes program can serve to shorten the time between the generation of new scientific and environmental monitoring objectives and the return of relevant data from space.

The Committee notes with concern that the requested funding for Tropical Rainfall Measurement Mission (TRMM) is lower in fiscal year 1992 than the funding provided in fiscal year 1991 and regrets the deletion of the Earth science attached payloads from the space station. Accordingly, the Committee has added $15,000,000 for Earth Probes to accelerate development of TRMM and to make alternative arrangements to fly the attached payloads deleted from the space station program.

SECTION 4(a)(1)(G) MATERIALS PROCESSING IN SPACE

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year 1992	$125,800,000
Fiscal Year 1993	$201,400,000
Fiscal Year 1994	$233,600,000

Committee Recommendation:

Fiscal Year:	
1992	$115,800,000
1993	$201,400,000
1994	$233,600,000

Committee authorization recommendation

Section 4(a)(1)(G) authorizes the appropriation of $115,800,000 in fiscal year 1992 for Materials Processing in Space. The Committee intends that the reduction of $10,000,000 from the President's request in fiscal year 1992 be applied to the Space Station Utilization budget line. The Committee adopted language which transfers $6,000,000 from the Space Station Utilization budget line in Materials Processing in Space to the Physics and Astronomy budget line for alternative flight provisions for the physics and astronomy attached payloads deleted from the space station. The remaining reduction of $4,000,000 in fiscal year 1992 reflects the effects of the restructured Space Station program and the need to

transition the utilization activities to life science after Permanent Manned Capability. In such case, materials science facilities and equipment scheduled to be available only after the PMC milestone will need to be reassessed. Section 4(a)(1)(G) also provides $201,400,000 in fiscal year 1993 and $233,600,000 in fiscal year 1994, in accordance with the President's request.

Program description

The Materials Processing in Space program uses the microgravity environment to conduct research in fundamental science, materials science, and biotechnology. The program includes ground-based research, Spacelab and space shuttle payload development and operations, and space station utilization planning and payload development.

Committee views

Reduction in Funding for Space Station Utilization

The Committee believes that NASA should make other arrangements to fly the attached payloads deleted from the space station, which were supported in previous years by the Space Station Utilization budget line. Accordingly, the Committee has transferred $6,000,000 from the Space Station Utilization line in Materials Processing in Space to the Physics and Astronomy line. In addition, the Committee has made an additional general reduction to the Space Station Utilization line, reflecting the Committee's concern that the programs to develop large materials processing facilities for the space station are not under control and that materials processing facilities scheduled to be available after Permanent Manned Capability should be reassessed.

SECTION 4(a)(1)(H) COMMUNICATIONS

President's request for fiscal year 1992 budget and estimates for subsequent years:

Fiscal Year 1992	$39,400,000
Fiscal Year 1993	$34,700,000
Fiscal Year 1994	$31,000,000

Committee Recommendation:

Fiscal Year:	
1992	$39,400,000
1993	$34,700,000
1994	$31,100,000

Committee authorization recommendation

Section 4(a)(1)(H) authorizes the appropriation of $39,400,000 in fiscal year 1992, $34,700,000 in fiscal year 1993, and $31,100,000 in fiscal year 1994 for Communications, in accordance with the President's request.

Program description

The main activity in communications is the Advanced Communications Technology Satellite (ACTS) program, including development of terminals for

use in the ACTS experiments program. The ACTS launch is scheduled for fiscal year 1993. Other components of the communications program include research and hardware development for advanced communications concepts, research and development for the search and rescue program, and radio science studies.

Committee Views

ACTS Experiments Program

The Committee strongly supports the transfer of the ACTS experiments program to the Office of Commercial Programs, which the Committee believes will place a greater emphasis on industry involvement. However, the Committee is concerned that the funding intended for an industry experiments program using ACTS may be excessively diluted by institutional expenditures and non-ACTS research activities of new Centers for the Commercial Development of Space (CCDS) if additional funds are not made available. The Committee believes that funding intended for an industry experiments program using ACTS should be sustained at a level that will guarantee direct ACTS utilization by industry and that this should be over and above resources directed at the establishment of the CCDSs.

SECTION 4(a)(1)(I) INFORMATION SYSTEMS

President's request for fiscal year 1992:
  Fiscal Year 1992.....$42,000,000
Committee Recommendation:
  Fiscal Year:
    1992.....$42,000,000

Committee authorization recommendation

Section 4(a)(1)(I) authorizes the appropriation of $42,000,000 in fiscal year 1992 for Information Systems. NASA plans to eliminate this budget line beginning in fiscal year 1993 and distribute its activities to other functions within the Office of Space Science and Applications.

Program description

The objective of the information systems program is to provide advanced data systems required to support flight projects in the Office of Space Science and Applications. In addition, in fiscal year 1992 NASA plans to initiate an effort to revitalize current space science data holdings.

Committee views

Funding for Preserving Existing Data and Handling New Data

Major science missions during the 1990s will lead to an explosion in data received. NASA's data archiving and distribution system will be severely stressed. Advances in information and data management systems are required if NASA is to support the need of the scientific community to access this data. In addition, NASA's previous efforts to preserve existing data archives have been found to be inadequate.

The Committee is concerned that the elimination of this budget line in future years will result in a reduced emphasis on preserving existing space science data and developing systems to cope with the torrents of new scientific data expected in the 1990's. The Committee urges NASA to provide the information systems program with the resources needed to preserve the existing data collected over the last 30 years and deal with the anticipated influx of new space science data.

SECTION 4(a)(1)(J) TECHNOLOGY UTILIZATION

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$32,000,000
1993	$31,700,000
1994	$33,000,000

Committee Recommendation:

Fiscal Year:	
1992	$27,000,000
1993	$29,700,000
1994	$33,000,000

Committee authorization recommendation

Section 4(a)(1)(J) authorizes the appropriation of $27,000,000 in fiscal year 1992, $29,700,000 in fiscal year 1993, and $33,000,000 in fiscal year 1994 for Technology Utilization.

Program description

The objectives of NASA's technology utilization programs are (1) to accelerate the application of new technology by the private sector; (2) to encourage secondary uses of NASA technology in non-aerospace fields, in both the public and private sectors; and (3) to develop applications of NASA's aerospace technology to meet non-aerospace needs. A network of Industrial Applications Centers (IAC's) and technology utilization officers at NASA centers form the core of the agency's technology transfer efforts. An open competition is planned to replace the current network of IAC's with six new centers geographically distributed around the country.

Committee views

Reduction in Rate of Funding Increase

The Committee strongly supports efforts to make NASA's technology transfer program more effective but believes that this can be accomplished within a more modest budget envelope. The Committee does not believe that the requested growth of more than thirty percent in fiscal year 1992 can be accomodated, especially given the large overall budget growth requested by the Office of Commercial Programs. Accordingly, the Committee has applied a general reduction of $5,000,000 to Technology Utilization in fiscal year 1992. The Committee believes that all activities within this budget line should share in the general reduction.

SECTION 4(a)(1)(K) COMMERCIAL USE OF SPACE

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$118,000,000
1993	$144,200,000
1994	$137,400,000

Committee Recommendation:

Fiscal Year:	
1992	$95,000,000
1993	$132,200,000
1994	$130,400,000

Committee authorization recommendation

Section 4(a)(1)(K) authorizes the appropriation of $95,000,000 in fiscal year 1992, $132,200,000 in fiscal year 1993, and $130,400,000 in fiscal year 1994 for Commercial Use of Space activities. The reduction from the President's request is without prejudice and shall be accomodated by means of a general reduction. The Committee takes this action reluctantly, but the rapid increase in funding required for the major flight programs envisioned must be fit into the overall funding allocation that is likely to be available for NASA.

Program description

The Commercial Use of Space program primarily supports a network of sixteen Centers for the Commercial Development of Space (CCDS). The CCDSs are located at state and private universities and research institutes. The purpose of the CCDS program is to encourage increased private sector investment in research geared toward examining potential commercial uses of space.

The scientific and engineering researchers at the CCDSs are supported by basic grants of approximately $1 million per center. In addition, NASA funds payload development, payload integration, shuttle integration, and transportation into space for CCDS experiments. NASA's support to the CCDSs totals over $100 million in the fiscal year 1992 budget request, nearly double the fiscal year 1991 budget. The remainder of this account supports commercial development studies, headquarters support contracts, and NASA field center collaborative work with industry.

Committee views

Budgetary Growth Associated with Flight Programs

The Committee is encouraged by NASA's ambitious plans for its Centers for the Commercial Development of Space (CCDS). The Committee nevertheless believes that the large bulge in the budget of the Office of Commercial Programs (OCP) over the next three fiscal years cannot be achieved in the current constrained budget climate. The Commercial Use of Space budget request for fiscal year 1992 is nearly twice the fiscal year 1991 budget. Most of this bulge is attributable to the simultaneous initiation of two

space transportation projects, Spacehab and COMET, which are intended to provide flights for experiments developed by NASA's CCDSs. For this reason, the Committee has made a general reduction of $23,000,000 in fiscal year 1992. This authorization still provides a greater than 50 percent increase in funding in fiscal year 1992.

The Committee notes that the practice of "front loading" commercial service contracts in order to establish a basis for investor confidence presents Congress with an untenable situation. That is, such contracts must be funded or such companies will encounter severe financial disruption. In addition, Congress must provide an inordinate amount of funding initially compared to the services received. The Committee intends to review the possibility of providing NASA with termination liability authority to alleviate these problems.

Industrial Participation

The Committee is encouraged by the large number of industrial affiliates who have worked with or expressed interest in the research being done by the CCDSs. However, a smaller number of these firms have provided significant cash support to the CCDSs and industry cash support remains a small percentage of total cash and in-kind support to the CCDS program. The Committee believes that it is essential that all of the research performed at the CCDSs be driven by interest from industry and receive direct financial support from industry. The Committee believes that the best measure of industrial interest in a project is direct financial (cash) support. The accounting methods for estimating the dollar value of in-kind support such as personnel and equipment do not appear to be consistent across the CCDSs and may not accurately reflect the value industry would place on this support. If NASA plans to continue using in-kind contributions as a measure of industry support, it should develop uniform standards for determining the value to industry of such contributions.

The Committee recommends that NASA consider ways to provide each center with greater incentives for obtaining industry funding for projects they propose to undertake. A matching fund program, whereby NASA provides a lower level of basic grant funding than it currently provides but matches industry cash contributions on a one-for-one or two-for-one basis up to some limit, would be one option for accomplishing this objective. Another option would be to prioritize payloads for flight based not just on technical merit but also on the amount of cash support received from industry. Projects with greater levels of industry support and equal technical merit should fly before projects with lower levels of support. A third option would be to require new CCDSs to list in their proposals the financial support from industry they will obtain if they receive a specific level of NASA support. NASA could evaluate the proposals based on the level of industry support and the credibility of such estimates.

Furthermore, the Committee notes that three of the CCDSs have received extremely little or no cash from industry. NASA originally planned to support the centers for only the first five years, after which time the centers would either become self-sustaining or would be discontinued. The Committee recommends that NASA consider periodically recompeting the contracts for CCDS status. New groups of researchers and industry partners

might be better able to take advantage of NASA's support. Since NASA is planning to issue a request for proposals for one or two new centers to concentrate on satellite communications research, the Committee recommends that NASA consider recompeting the contracts for the three CCDSs that have not attracted industry funding and maintain the total number of CCDS at sixteen. Maintaining a fixed number of CCDSs at this time is consistent with the inability to provide all of the large budget growth requested by the Office of Commercial Programs.

The Committee requests that NASA provide it with a report, by November 1, 1991, outlining NASA's plans for increasing the incentives for centers to obtain industry cash support, describing NASA's review process for evaluating the level of industry support obtained by the centers, and describing NASA's plans for periodically recompeting the CCDS contracts. The Committee also strongly suggests that NASA require each CCDS to include in its annual report to NASA a detailed breakdown of cash and in-kind support received from industry.

SECTION 4(a)(1)(L) AERONAUTICAL RESEARCH AND TECHNOLOGY

President's request for fiscal year 1992 and estimates for subsequent years:
  Fiscal Year:
    1992.....$
    1993.....$
    1994.....$
Committee Recommendation:
  Fiscal Year:
    1992.....$
    1993.....$
    1994.....$

Committee authorization recommendation

Section 4(a)(1)(L) authorizes

Program description

Committee views

SECTION 4(a)(1)(M) TRANSATMOSPHERIC RESEARCH AND TECHNOLOGY

President's request for fiscal year 1992 and estimates for subsequent years:
  Fiscal Year:
    1992.....$
    1993.....$
    1994.....$
Committee Recommendation:
  Fiscal Year:
    1992.....$
    1993.....$
    1994.....$

Committee authorization recommendation

Section 4(a)(1)(M) authorizes

Program description

Committee views

SECTION 4(a)(1)(N) SPACE RESEARCH AND TECHNOLOGY

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$354,800,000
1993	$321,700,000
1994	$317,200,000

Committee Recommendation:

Fiscal Year:	
1992	$324,800,000
1993	$351,700,000
1994	$367,200,000

Committee authorization recommendation

Section 4(a)(1)(N) authorizes $324,800,000 in fiscal year 1992 for Space Research and Technology activities. This represents a decrease of $30,000,000 below the President's request. This decrease reflects the combined effect of: an increase of $10,000,000 in the Research and Technology Base to initiate a research and development program focused on developing propulsion, guidance & control, vehicle, ground support, and other technologies that could benefit the commercial launch vehicle industry within the United States; and a decrease of $40,000,000 in Space Automation and Telerobotics reflecting the deletion of the $55,000,000 Flight Telerobotic Servicer project, and the reallocation of $15,000,000 to other automation and telerobotic activities.

Section 4(a)(1)(N) also authorizes the appropriation of $351,700,000 in fiscal year 1993, and $367,200,000 in fiscal year 1994 for Space Research and Technology activities. The authorization for fiscal year 1993 is based on an Administration estimate of $321,700,000, and the addition of $30,000,000 for the continued development of technologies in support of the commercial launch vehicle industry. The authorization for fiscal year 1994 is based on an Administration estimate of $317,200,000, and the addition of $50,000,000 for the continued development of technologies in support of the commercial launch vehicle industry.

Program description

The overall goal of the Space Research and Technology program is to ensure continued U.S. leadership in space by providing advanced, enabling technologies, validated at a level suitable for user-readiness, for future space missions. To achieve this goal, a broad base of advanced technology is required for vehicle and subsystem concepts, components, devices, and software. This is achieved by developing technical strengths in the engineering disciplines within NASA, industry, and academia and performing critical technology validations that facilitate the transfer of new technology with a high level of confidence to future space missions.

Committee view

R&D Support for Commercial Launch Vehicle Industry

The Committee continues to be concerned with the lack of progress over the past four years in establishing a focused program to develop and expand technologies that would be of value to the commercial launch vehicle industry within the United States.

The Committee has often noted the tremendous value that NASA's research and development initiatives have provided the commercial aircraft industry. These initiatives have been invaluable in helping to develop and maintain this key industry as the largest and most dynamic in the world. As such, this industry continues to provide the largest positive contribution to this country's balance of payments than any other industrial sector.

As in the past, the Committee continues to believe that the research and development support that NASA has long provided to the commercial aircraft industry in this country provides an excellent model for the type of support that NASA should provide to the commercial launch vehicle industry.

The commercial launch vehicle industry in this country finds itself at a distinct disadvantage when trying to compete in the world marketplace. In large part, this disadvantage has been due to the research and development and technical support that other countries have provided to their launch vehicle industries.

This Committee believes that NASA should take steps to assist the commercial launch vehicle industry in this country to become more competitive in the world marketplace. To assist in this effort, the Committee has provided funds that could be used to establish a focused program of developing the propulsion, guidance and control, vehicle, ground support and other technologies that could benefit the commercial launch vehicle industry in this country.

The Committee is aware of a study conducted by the Department of Transportation's Commercial Space Transportation Advisory Committee which recommends a similar component technology program. The Committee recommends that this be considered as a basis for the NASA effort. Further close cooperation between NASA and DOT on this issue would be highly beneficial.

Flight Telerobotic Servicer

The Flight Telerobotic Servicer (FTS) was a teleoperated robotic system that was being developed for use in the assembly and maintenance of Space Station Freedom. The critical design review (CDR) for the FTS demonstration test flight (DTF-1) was completed in the fall of 1990. However, the Space Station program office decided to delete the FTS development from the Space Station program. In the fiscal year 1992 budget request, NASA has transferred the FTS program to the Space Research and Technology budget line. It would account for the majority of the funding requested for space automation and robotics in fiscal year 1992. NASA has indicated that it will review the current FTS program plan to see whether it should be modified. The Committee believes that since the original mission of the FTS has been eliminated, the NASA telerobotics program

should be structured in a way that maximizes the long-term technological gains to be realized from the program. In addition, the program should contribute to the development of U.S. commercial capabilities in teleoperated robotic systems. Two other areas in which research and development activity could provide real benefits are in teleoperated Space Station or free-flyer payload technologies, and in the development of micro rover and other microtechnolgy applications for lunar and planetary exploration.

The Committee therefore reduces the funding requested for the FTS program by $30,000,000. Of the remaining $25,000,000, $10,000,000 is transferred to the Research and Technology Base, and the balance is provided for research on telerobotics, teleoperated payload technologies, and for research on applications of microtechnology to robotic space exploration.

SECTION 4(a)(1)(O) EXPLORATION ACTIVITIES

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$ 67,000,000
1993	$ 88,000,000
1994	$102,400,000

Committee Recommendation:

Fiscal Year:	
1992	$ 61,000,000
1993	$ 88,000,000
1994	$102,400,000

Committee authorization recommendation

Section 4(a)(1)(O) authorizes $61,000,000 in fiscal year 1992. The reduction from the President's request for FY 1992 shall be accommodated by means of a general reduction of $6,000,000. Section 4(a)(1)(O) also authorizes $88,000,000 in fiscal year 1993, and $102,400,000 in fiscal year 1994 for Exploration Activities.

Program description

The Exploration Activities budget line funds Exploration Technology and Exploration Mission Studies. The Exploration Technology program is intended to develop advanced technologies that will support not only the Space Exploration Initiative (SEI), but will also be applicable to other areas of the nation's civil space effort.

Exploration mission studies are intended to develop the preliminary technical, scientific, and programmatic data needed to allow future decisions on the proper approach to human and robotic exploration of the Moon and Mars. In fiscal year 1992, the Exploration Mission Studies are to incorporate the findings of the Synthesis Group's studies into its analyses.

Committee views

SP-100 Reactor Program

The SP-100 program is a joint activity of NASA, the Department of Defense, and the Department of Energy. The objective of the program is to develop a space nuclear power system. Since the program was initiated in the early 1980s, it has undergone several rephasings and the milestones have been delayed. The Committee is concerned that NASA's exploration requirements are not adequately addressed in the SP-100 program, especially since NASA's requirements include the capability to provide power on planetary surfaces under harsh conditions, whereas the Department of Defense requirements are focussed more on the development of an in-space system. The Committee would like to be kept informed about the status of the exploration-related aspects of the SP-100 program and how the exploration-related requirements for the program are being addressed.

Synthesis Group

The Synthesis Group has been examining alternative approaches to the conduct of the Space Exploration Initiative. The Synthesis Group is scheduled to report its findings in April 1991. The Committee is interested in how NASA will respond to the report of the Synthesis Group and how NASA proposes to incorporate the findings into its Exploration Technology and Mission Studies activities. The Committee directs NASA to provide a report to the Committee on its response to the findings and recommendations of the Synthesis Group, as well as its plans for incorporating those findings into its activities in fiscal year 1992. The Committee requests that the report be delivered to Congress within six months of the release of the Synthesis Group's report.

SECTION 4(a)(1)(P) SAFETY, RELIABILITY & QUALITY ASSURANCE

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$33,600,000
1993	$32,500,000
1994	$34,000,000

Committee Recommendation:

Fiscal Year:	
1992	$33,600,000
1993	$32,500,000
1994	$34,000,000

Committee authorization recommendation

Section 4(a)(1)(P) authorizes $33,600,000 in fiscal year 1992 for Safety, Reliability, and Quality Assurance activities. This authorization is equal to the President's request.

Section 4(a)(1)(P) also authorizes $32,500,000 in fiscal year 1993 and $34,000,000 in fiscal year 1994 for Safety, Reliability, and Quality

Assurance activities. These authorization levels are equal to the Administration's estimates.

Program description

The Safety, Reliability, and Quality Assurance program within NASA is intended to reduce the overall level of risk within the Agency's projects and activities. This is accomplished through such activities as the conduct of independent assessments, reviews, analyses, studies, and tests; the establishment of standards and guidelines; and the development of new inspection technologies, techniques, and devices.

SECTION 4(a)(1)(Q) ACADEMIC PROGRAMS

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$64,600,000
1993	$70,500,000
1994	$74,500,000

Committee Recommendation:

Fiscal Year:	
1992	$64,600,000
1993	$70,500,000
1994	$74,500,000

Committee authorization recommendation

Section 4(a)(1)(Q) authorizes the amounts contained in the President's request for fiscal years 1992 through 1994.

Program description

NASA's Academic Programs conduct aerospace educational programs and activities to inspire and support, in elementary through graduate school, students to prepare themselves for careers in science, engineering and technology. Funding initiated in fiscal year 1992 will allow for the continuation of the current program including the continuation of the Graduate Student Researchers program at the Kennedy Space Center.

Committee views

Educational Goals of the Human Exploration Program

The Committee has considered NASA's contribution to the Nation's educational system one of the greatest benefits and highest priorities of the space program. The recent recognition of an overall decline in American educational standards compared to other industrialized nations makes this priority all the more important.

The Committee notes and commends the establishment of education as one of the long term goals of the Space Exploration Initiative. The Committee further recognizes that present extrapolations of the science and

engineering Phd work force necessary to carry out a robust Space Exploration Initiative falls short of what will be needed. Therefore, the Committee believes that NASA should undertake all practicable measures to assess and remedy this shortfall. These may entail a combination of societal educational programs aimed at secondary educational levels together with direct academic research programs which provide graduate and post graduate employment opportunities.

SECTION 4(a)(1)(R) TRACKING AND DATA ADVANCED SYSTEMS

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year 1992	$22,000,000
Fiscal Year 1993	$23,200,000
Fiscal Year 1994	$24,600,000

Committee Recommendation:

Fiscal Year:	
1992	$22,000,000
1993	$23,200,000
1994	$24,600,000

Committee authorization recommendation

Section 4(a)(1)(R) authorizes the appropriation of $22,000,000 in fiscal year 1992, $23,200,000 in fiscal year 1993, and $24,600,000 in fiscal year 1994 for Tracking and Data Advanced Systems.

Program description

The Tracking and Data Advanced Systems program provides for higher performance, higher reliability, and more cost-effective tracking and data handling capabilities for future space missions. This program is the research and development component of the Office of Space Operations, which runs the ground and space networks and the control and data acquisition facilities supporting all space flight missions.

SECTION 4(a)(2)(A) SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:

1992	$1,288,900,000
1993	$1,277,000,000
1994	$1,210,500,000

Committee Recommendation:

Fiscal Year:

1992	$1,358,900,000
1993	$1,277,000,000
1994	$1,210,500,000

Committee authorization recommendation

Section 4(a)(2)(A) authorizes $1,358,900,000 in fiscal year 1992 to support Shuttle Production and Operational Capability. This represents an increase of $70,000,000 above the President's request. This increase is the combined effect of: a $30,000,000 increase in Orbiter Operational Capability to provide additional support to maintain the readiness of the Orbiter production line and related production activities of Orbiter sub-contractors; a $50,000,000 increase in Propulsion Systems reflecting a transfer in this amount from the Construction of Facilities account to the Advanced Solid Rocket Motor program; and a $10,000,000 decrease in Assured Shuttle Availability deferring development of the Multifunction Electronic Display System. The Advanced Solid Rocket Motor program is authorized funding of $375,000,000.

Section 4(a)(2)(A) also authorizes $1,277,000,000 in fiscal year 1993 and $1,210,500,000 in fiscal year 1994 for Shuttle Production and Operational Capability. These authorization levels are equal to the Administration's estimates. However, the Committee questions the accuracy of these estimates given the lack of funding they provide for the Advanced Solid Rocket Motor program.

The Committee recognizes that the funds provided in fiscal year 1992 may not be sufficient to meet the needs of authorized Space Shuttle Production and Operational Capability programs. The Committee also recognizes that there may be additional funding flexability wihin the Space Shuttle Operations account. Accordingly, the Committee would entertain a request to transfer funds from the Space Shuttle Operations account into the Space Shuttle Production and Operational Capability account.

Program description

The objectives of the Shuttle Production and Operational Capability program are to provide for necessary design modifications and safety improvements to support the Space Shuttle; needed capabilities at the launch site and for the flight operations process; continued development and testing of propulsion systems; and replacement of obsolete systems to ensure the long-term viability of the Shuttle program.

Committee view

Orbiter Production Readiness

In 1989, the Committee directed NASA to develop a long-range plan for handling the production line for Space Shuttle Orbiters. The Committee expressed increasing concern for the lack of such a policy and the resulting year-to-year nature of NASA's plans for this important production capability. NASA was directed to develop this long-range plan and submit it to the Congress by March 1, 1990.

The Committee finally received an "interim report" on NASA's efforts to produce such a plan on August 10, 1990. The Committee was informed that it would receive a completed detailed plan by October 1990. The Committee still has not received this completed plan.

The Committee is concerned that this continual lack of definitive action on the part of the Administrator may threaten the viability of the Orbiter production line through the loss of key prime contractor and sub-contractor capabilities.

The Committee has stated in the past that it could understand a decision by NASA to close down this production line if it were consciously made and well supported. On the other hand, simply permitting this production line and those of its sub-contractors to atrophy because of indecision and inaction is not in the public interest.

Accordingly, the Committee has taken action to preserve this production capability by once again authorizing an augmentation of funding support for structural spares and maintaining the readiness of the Orbiter production line and related production activities of Orbiter sub-contractors.

The Committee expects NASA to move with all deliberate speed in completing the Committee-directed long-range plan for the Space Shuttle production line. Until the completion and acceptance of this plan by the Congress, NASA should take whatever steps are required to preserve this production capability until a decision is reached regarding how it should be handled over the long term.

SECTION 4(a)(2)(B) SPACE SHUTTLE OPERATIONS

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$3,023,600,000
1993	$3,059,800,000
1994	$3,161,200,000
Committee Recommendation:	
Fiscal Year:	
1992	$2,970,600,000
1993	$2,968,800,000
1994	$2,897,200,000

Committee authorization recommendation

Section 4(a)(2)(B) authorizes $2,970,600,000 in fiscal year 1992 for Space Shuttle Operations. This represents a decrease of $53,000,000 below the President's request. This decrease is a result of the combined effect of: a $14,000,000 reduction in operating costs due to the cancellation of the Flight Telerobotic Servicer Space Shuttle mission in 1994, cancellation of the Space Shuttle "Flight Opportunity" in 1995, and movement of the Aeroassist Flight Experiment Space Shuttle mission from 1995 to 1996; and a $39,000,000 reduction in operating costs due to anticipated efficiencies in the Space Shuttle program consistent with a goal of four percent savings per year in operating costs. The $39,000,000 reduction in operating costs is based on an assumed four percent savings minus the $85,000,000 savings reduction that has already been made by the Office of Management and Budget.

Section 4(a)(2)(B) also authorizes $2,968,800,000 in fiscal year 1993 and $2,897,200,000 in fiscal year 1994 for Space Shuttle Operations. The authorization for fiscal year 1993 is based on an Administration estimate of $3,059,800,000 and a reduction of $91,000,000. This reduction is the result the combined effect of: a $46,000,000 reduction in operating costs due to the cancellation of the Flight Telerobotic Servicer Space Shuttle mission in 1994, cancellation of the Space Shuttle "Flight Opportunity" in 1995, and movement of the Aeroassist Flight Experiment Space Shuttle mission from 1995 to 1996; and a $45,000,000 reduction in operating costs due to anticipated efficiencies in the Space Shuttle program consistent with a goal of four percent savings per year in operating costs. The $45,000,000 reduction in operating costs is based on an assumed eight percent savings minus the $217,000,000 savings reduction that has already been made by the Office of Management and Budget.

The authorization for fiscal year 1994 is based on an Administration estimate of $3,161,200,000 and a reduction of $264,000,000. This reduction is the result the combined effect of: a $73,000,000 reduction in operating costs due to the cancellation of the Flight Telerobotic Servicer Space Shuttle mission in 1994, cancellation of the Space Shuttle "Flight Opportunity" in 1995, and movement of the Aeroassist Flight Experiment Space Shuttle mission from 1995 to 1996; and a $191,000,000 reduction in operating costs due to anticipated efficiencies in the Space Shuttle program consistent with a goal of four percent savings per year in operating costs. The $191,000,000 reduction in operating costs is based on an assumed twelve percent savings minus the $214,000,000 savings reduction that has already been made by the Office of Management and Budget.

Program description

Space Shuttle Operations provides for Space Shuttle launch services for NASA payloads, and, on a reimbursable basis, for those of the Department of Defense, other civil agencies, and certain commercial and international users. Within this account, flight hardware is produced, refurbished, and repaired; and manpower, propellants, and other materials are furnished to conduct and support both flight and ground operations. Operations funding

also provides for the purchase of replacement spares for both flight and ground support hardware as existing inventories of spare parts are consumed as a result of flight-related activities.

Committee view

Cost Savings In the Space Shuttle Program

Two years ago, this Committee directed NASA to conduct a study to determine what efficiencies could be adopted within the Space Shuttle program to help offset the cost growth in excess of one billion that has occurred in the last several years. As stated in H.R. 1759,the National Aeronautics and Space Administration Multiyear Authorization Act of 1989, H. Rept. 101-226, the Committee encouraged NASA managers to be vigilant for changes in organization, procedures, operations, staffing, hardware design, etc. which could result in a reduction in the funds required to support the Space Shuttle program while causing no reduction in quality and safety.

The Committee report which NASA submitted in April 1990 in response to this requirement largely contained initiatives that have been in existence for a long time, some of which even predated the Challenger accident.

The Committee continues to believe that it should be possible to achieve savings in the Space Shuttle program without sacrificing quality and safety. This belief been reinforced by recent testimony to this Committee by key NASA officials.

For example, the Deputy Administrator testified on February 7, 1991 that it should be possible to reduce the annual cost of operating the Space Shuttle by 20 to 25 percent. Subsequently, on March 6, 1991, NASA's Associate Administrator for Space Flight testified that a 25 percent reduction in Space Shuttle operating costs could be taken as a goal and that he anticipated that a target for achieving that goal would be to achieve savings of three to five percent per year for about five years. He added that the savings would have to be achieved this way in order to maintain safety.

The Committee strongly supports this continued emphasis that NASA is placing on maintaining quality and safety within the Space Shuttle program. Additionally, the committee also supports whatever actions NASA can take to achieve cost savings within this program without jeopardizing quality and safety. In this regard, the committee believes that the Associate Administrator for Space Flight's anticipated target of achieving three to five percent savings for a period of five years is a reasonable goal.

The Committee directs NASA to report to the Congress by March 1, 1992 on exactly how it would begin to achieve this annual cost savings of three to five percent in the Space Shuttle program.

SECTION 4(a)(2)(C) EXPENDABLE LAUNCH VEHICLES AND SERVICES

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:
1992.....$341,900,000
1993.....$281,000,000
1994.....$315,800,000
Committee Recommendation:
Fiscal Year:
1992.....$317,900,000
1993.....$259,000,000
1994.....$309,800,000

Committee authorization recommendation

Section 4(a)(2)(C) authorizes $317,900,000 in fiscal year 1992 for Expendable Launch Vehicles and Services. This represents a $24,000,000 decrease below the President's request reflecting the Committee's deletion of funding for the MSAT launch vehicle.

Section 4(a)(2)(C) also authorizes $259,000,000 in fiscal year 1993 and $309,800,000 in fiscal year 1994 for Expendable Launch Vehicles and Services. The authorization for fiscal year 1993 is based on an Administration estimate of $281,000,000 and a decrease of $22,000,000 reflecting the Committee's deletion of funding for the MSAT launch vehicle. The authorization for fiscal year 1994 is based on an Administration estimate of $315,800,000 and a decrease of $6,000,000 reflecting the Committee's deletion of funding for the MSAT launch vehicle. The Committee notes that it questions the accuracy of these estimates given the lack of funding they provide for the purchase of launch vehicles for TDRS-C, AXAF, CRAF, and Lifesats.

Program description

Funding for Expendable Launch Vehicles and Services provides launch services for unmanned civil U.S. government space missions that do not require the Space Shuttle's unique capabilities. Consistent with the Commercial Space Launch Act, Public Law 98-575, as amended, expendable launch vehicle services are to be acquired from the U.S. private sector whenever possible.

Committee view

Deletion of Funding for the MSAT Launch Vehicle

The Committee has deleted the funding intended to pay part of the cost of a launch vehicle for the mobile communications satellite (MSAT) planned by the American Mobile Satellite Corporation (AMSC). The Committee notes that a recent U.S. Court of Appeals decision has effectively rescinded the license granted to this corporation by the Federal Communications Commission (FCC). The court found that the FCC was acting at the periphery of its authority and did not demonstrate truly compelling reasons for forcing the applicants for a mobile satellite communications license into a single consortium.

Given this situation, it appears that the FCC will have to reconsider the license applications for mobile satellite service, a process which may

take some time. As such, approval of this funding would be premature and the purpose for which this funding is intended may change significantly. Furthermore, the Committee believes that it would be preferable for federal agencies interested in obtaining mobile satellite services to purchase such services directly from AMSC or other providers as required, not through NASA or using funds from NASA's budget. The Committee does not believe that NASA should serve as a federal coordinator for operational services offered by commercial telecommunications firms.

SECTION 4(a)(2)(D) SPACE AND GROUND NETWORKS, COMMUNICATIONS, AND DATA SYSTEMS

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year 1992	$953,873,000
Fiscal Year 1993	$1,066,000,000
Fiscal Year 1994	$1,077,500,000

Committee Recommendation:

Fiscal Year:	
1992	$ 920,873,000
1993	$1,066,000,000
1994	$1,077,500,000

Committee authorization recommendation

Section 4(a)(2)(D) authorizes the appropriation of $920,873,000 in fiscal year 1992, $1,066,000,000 in fiscal year 1993, and $1,077,500,000 in fiscal year 1994 for Space and Ground Networks, Communications, and Data Systems. The $33,000,000 general reduction in fiscal year 1992 is without prejudice and may be absorbed by the elimination of the payment to the Federal Financing Bank for the Tracking and Data Relay Satellite System (TDRSS).

Program description

This program provides vital tracking, telemetry, command, data acquisition, communications, and data processing support to meet the requirements of all NASA flight projects. In addition, support is provided on a reimbursable basis for projects of the Department of Defense, other Government agencies, commercial firms, other countries, and international organizations.

Committee views

Adequacy of Funding

The Committee is concerned about this program's ability to adequately support the large number of missions scheduled for the 1990s given the requested budget levels. The delay in the launch of the Earth Observing System and the restructuring of the space station have led some requirements to slip. Nevertheless, the Committee believes that delaying planned improvements of aging and inefficient equipment may threaten NASA's ability to support future space flight missions in a cost-effective manner

and result in greater long-term costs for developing and operating ground systems.

Advanced Tracking and Data Relay Satellite

The Committee notes that NASA has taken several positive steps in the fiscal year 1992 budget request. The cancellation of funding for the Tracking and Data Relay Satellite (TDRS) Flight 8 spacecraft and the shift of TDRS Flight 7 to an expendable launch vehicle, actions recommended by this Committee, are particularly noted. At the same time, the Committee notes with concern that the start of procurement for the Advanced Tracking and Data Relay (ATDRS) has been further delayed.

The Committee views the ATDRS series as an opportunity to establish a more efficient and cost-effective tracking and data relay network. The Committee believes that ATDRS should take advantage of advanced technologies where they promise better performance at lower cost, as long as the technical and programmatic risks are consistent with an operational project. The Committee also believes that the operational nature of the ATDRS series promises significant cost savings. The high reliability of commercial communications satellites procured under fixed-price contracts suggests that this approach might lower the Government's procurement costs. In particular, the Committee notes that the Navy is procuring its UHF Follow-On satellites under a commercial-like contract. The UHF Follow-On contractor will build the satellites under a fixed-price contract, procure launch services, and deliver the satellites to the Navy on-orbit.

The Committee recognizes that high technical risk or the need to make changes to the specifications or design during the development phase would make a cost-plus contract more appropriate. However, the Committee also recognizes that high technical risk and poorly defined performance specifications are incompatible with an operational program. The Committee believes that NASA should not be in the business of engineering operational communications satellites and should, to the extent practicable and reasonable, provide the potential contractors with performance specifications rather than detailed design specifications. Accordingly, the Committee urges NASA to carefully consider the potential advantages of procuring ATDRS under a fixed-price contract. As a minimum, the Committee believes that NASA should consider an arrangement whereby the first ATDRS satellite is procured on a cost-plus basis and additional models procured on a fixed-price basis. The Committee also intends that NASA take all possible steps to reduce the time currently planned for evaluating the ATDRS proposals and selecting a contractor. The time currently allotted to this activity appears to exceed what would be considered reasonable and customary for other procurements of operational spacecraft.

SECTION 4(A)(3) CONSTRUCTION OF FACILITIES

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$480,300,000
1993	$469,800,000
1994	$541,600,000

Committee Recommendation:
Fiscal Year:
1992.....$430,300,000

Committee authorization recommendation

Section 4(a)(3) authorizes $430,300,000 for "Construction of Facilities." This authorization represents a $50,000,000 reduction in the Administration's request, reflecting a transfer in that ammount from the Advanced Solid Rocket Motor project to the Space Shuttle Production and Operational Capability account. The Committee intends to continue to authorize institutional programs on an annual basis in order to more closely monitor specific expenditures and to ensure that these programs remain responsive to evolving agency needs.

The authorization bill drafted by NASA for fiscal year 1992 reduces the total of the amounts authorized for "Construction of Facilities" by $5,700,000 to $480,300,000 because of expected changes by the administration to the Davis-Bacon Act. NASA's action reflects the President's Budget statement for fiscal year 1992 that endorsed regulatory and legislative reform of the Davis-Bacon Act, including raising the threshold for contracts subject to the Act's provisions from $2,000 to $250,000.

The Davis-Bacon Act of 1931, Public Law 798, 71st. Cong., as amended, requires that construction contracts entered into by any agency of the Federal Government specify minimum wages to be paid to the various classes of laborers and mechanics employed under those contracts. The term "construction" includes direct construction, and the alteration or repair of public buildings and public works, including painting and decorating.

While the Davis-Bacon Act has enjoyed considerable support in Congress since its enactment, Congress has also devoted a significant amount of time to reviewing the Act in the past three decades. Changes to the Act during this time, however, have been minimal.

Accordingly, it is the Committee's intention that if the savings NASA expects from legislative and regulatory changes to the Davis-Bacon Act do not materialize, NASA shall absorb any shortfall from within amounts authorized under section 4(a)(3)(U) through (Y).

Program description

Section 4(a)(3) authorizes appropriations for contractual services for the repair, rehabilitation, and modification of existing facilities to maintain, upgrade, and improve the usefulness of the NASA physical plant; the construction of new facilities and the acquisition of related facility equipment needed to support science, space technology, and aeronautical research; environmental compliance and restoration activities; the design of facilities projects; and advanced planning related to future facilities needs.

The projects and amounts in the budget estimates reflect requirements for Space Station Freedom and Space Flight facilities, including the

Advanced Solid Rocket Motor Program, that are time-sensitive to meet certain specific program objectives. Other program requirements for fiscal year 1992 include modernization of the industrial area chilled water system rehabilitation, and expansion of the communications duct banks, and replacement of the 15 kilowatt load break switches at the Kennedy Space Center; repair of the site water system at the White Sands Test Facility; replacement of two central plant chillers and a boiler at the Johnson Space Center; completion of modifications to the X-Ray Calibration Facility in support of the advanced X-Ray Astrophysics Facility (AXAF) at the Marshall Space Flight Center; restoration and modernization of the high voltage distribution system and construction of a data information system facility in support of the Earth Observing System (EOS) program at the Goddard Space Flight Center; modernization of the main electrical substation at the Jet Propulsion Laboratory; continuation of restoration of utilities at the Wallops Flight Facility; **projects to repair, restore, and modernize NASA's aeronautical research and development facilities at Ames, Lewis, and Langley Research Centers;** and construction of a data interface facility and rehabilitation of the Tracking and Data Relay Satellite System (TDRSS) ground terminal at the White Sands Test Facility in New Mexico.

The fiscal year 1992 program continues to meet the objectives of preserving and enhancing the capabilities and usefulness of existing facilities and ensuring safe, economical, and efficient use of the NASA physical plant. This request continues the necessary rehabilitation and modification program begun in prior years and continues a responsive repair program. The repair program restores facilities to a condition substantially equivalent to their originally designed capability. The minor construction program continues to provide a means to accomplish smaller facility projects which accommodate changes in technical and institutional requirements. The environmental compliance and restoration program ensures that statutory environmental requirements are met and any necessary remedial actions are promptly taken.

Funds requested for facility planning and design cover advance planning for potential future projects, master planning, facilities studies, engineering reports and studies and the preparation of facility project design drawings and bid specifications.

* Language highlighted in this section is to be added by the Technology and Competitiveness Subcommittee.

45-078 O—91——23

SECTION 4(a)(4) RESEARCH AND PROGRAM MANAGEMENT

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$2,452,300,000
1993	$2,492,600,000
1994	$2,495,400,000

Committee Recommendation:

Fiscal Year:	
1992	$2,422,300,000

Committee authorization recommendation

Section 4(a)(4) authorizes $2,422,300,000 for F.Y. 1992. A reduction of $30,000,000 has been made without prejudice and may be absorbed by deferral of those costs associated with moving the NASA headquarters location. The Committee will continue to authorize Research and Program Management on an annual basis.

SECTION 4(a)(5) INSPECTOR GENERAL

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$14,600,000
1993	$15,300,000
1994	$15,700,000

Committee Recommendation:

Fiscal Year:	
1992	$14,600,000
1993	$15,300,000
1994	$15,700,000

Committee authorization recommendation

Section 4(a)(5) authorizes funding in the full amount of the President's request for activities undertaken by the Inspector General in fiscal years 1992 through 1994.

SECTION 5: CONSTRUCTION OF FACILITIES REPROGRAMMING

SECTION 6: SPECIAL REPROGRAMMING AUTHORITY FOR CONSTRUCTION OF FACILITIES

SECTION 7: CONSIDERATION BY COMMITTEES

SECTION 8: SMALL BUSINESS INNOVATION RESEARCH PROGRAM

SECTION 9: OFFICE OF FACILITIES MAINTENANCE

SECTION 10: COMMERCIAL SPACE LAUNCH ACT AMENDMENT

Section 10 authorizes the appropriation of $5,104,000 in fiscal year 1992 for the Office of Commercial Space Transportation. This amount is identical to the President's request for this office.

SECTION 11: NATIONAL SPACE COUNCIL AUTHORIZATION

Section 11(a) authorizes the appropriation of $1,491,000 in fiscal year 1992 to carry out the activities of the National Space Council established by section 501 of the NASA Authorization Act, Fiscal Year 1989 (42 U.S.C. 2471).

Section 11(b) expresses the sense of Congress that the National Space Council should develop policy recommendations for the follow-on program to Landsat 6.

SECTION 12: OFFICE OF SPACE COMMERCE AUTHORIZATION

Section 12 authorizes the appropriation of $491,000 in fiscal year 1992 for the Office of Space Commerce.

SECTIONAL ANALYSIS

A bill to authorize appropriations to the National Aeronautics and Space Administration for Research and Development; Space Flight Control, and Data Communications; Construction of Facilities; Research and Program Management; the Inspector General; and for other purposes.

TITLE I.--NATIONAL AERONAUTICS AND SPACE CAPITAL DEVELOPMENT PROGRAM

SECTION 1--SHORT TITLE

Section 1 designates that the act may be cited as the "National Aeronautics and Space Administration Multiyear Authorization Act of 1991".

SECTION 2--FINDINGS

Section 2 includes a finding that the United States space program contributes to the nation's competitive advantage in technology and expresses the need for a sustained commitment of financial and human resources to the space program.

SECTION 3--POLICY

Section 3 would direct increased funding for the space program, emphasize the need for a healthy balance between manned and unmanned space activities, and maintain a mixed fleet by utilizing commercial expendable launch vehicles.

SECTION 4--AUTHORIZATION OF APPROPRIATIONS

Section 4 authorizes appropriations for fiscal years 1992, 1993, and 1994.

SECTION 5--CONSTRUCTION OF FACILITIES REPROGRAMMING

Section 5 provides authority to transfer the amounts authorized for specific construction of facilities projects to meet unanticipated cost variations.

SECTION 6--SPECIAL REPROGRAMMING AUTHORITY FOR CONSTRUCTION OF FACILITIES

Section 6 provides authority to transfer funds appropriated for Research and Development, , and Spaceflight Control and Data Communicaitons to Construction of Facilities in order to account for new deveopments or scientific or engineering changes in the national aeronautical and space program.

SECTION 7--CONSIDERATION BY COMMITTEES

Section 7 requires the Administrator to give notice to the appropriate authorizing committees before using appropriations for any program not

authorized or for an amount in excess of that authorized.

SECTION 8--SMALL BUSINESS INNOVATION RESEARCH PROGRAM

SECTION 9--OFFICE OF FACILITIES MAINTENANCE

SECTION 10--COMMERCIAL SPACE LAUNCH AMENDMENT

Section 10 authorizes $5,104,000 in fiscal 1992 for the Office of Commercial Space Transportation.

SECTION 11--NATIONAL SPACE COUNCIL AUTHORIZATION

Section 11 authorizes $1,491,000 in fiscal year 1992 to carry out the activities of the National Space Council.

SECTION 12--OFFICE OF SPACE COMMERCE AUTHORIZATION

Section 12 authorizes $491,000 in fiscal 1992 for the Office of Space Commerce.

EFFECTS OF LEGISLATION ON INFLATION

In accordance with Rule XI, Clause 2(1)(4) of the Rule of the House of Representatives this legislation is assessed to have no adverse long-run inflationary effects on prices and cost in the operation of the national economy. NASA expenditures are labor intensive, with approximately 80 percent of spending directly for jobs and the remainder for materials. In fiscal year 1991, NASA will employ about 23,829 civil servants and support about 199 thousand contractor and support services employees. Assuming a multiplier effect of 2.5, the total short-run employment effect on the United States' economy in fiscal year 1990 is about 557,000 jobs. In fiscal year 1992, NASA will employ 24,197 civil servants and support about 217 thousand contractor and support services employees. Assuming a multiplier effect of 2.5, the total short-run employment effect on the United States economy in fiscal year 1991 is about 603,000 jobs. This represents less than one-half of one percent of the total civilian labor force in the United States--too small to have a significant national effect. There could be some specific cases of industrial and regional employment and price changes influenced by NASA expenditures.

The most significant economic effects of NASA spending is the long-run productivity advance from new technologies developed for the space and aeronautics programs. Many NASA-sponsored advances in air and space transportation, communication satellites, remote sensing satellites, and other innovations have improved the productive capacity of industry and stimulated the development and growth of many new businesses.

NASA is actively pursuing its role to expand the opportunitites for private industry to gain access into space effectively and economically use space for commercial ventures. These expanded business opportunities have stimulated and are expected to continue to stimulate more productive, non-inflationary private sector economic growth, job creation and improve the United States competitive economic position in the world, e.g., improve

United States trade balance.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
BUDGET SUMMARY
In Millions of Dollars

	FY 1991	FY 1992 AUTHORIZATION		FY 1993 AUTHORIZATION		FY 1994 AUTHORIZATION		
	Approp	Pres Rqst	House Auth	Pres Est	House Auth	Pres Est	House Auth	Comments
RESEARCH AND DEVELOPMENT	6,023.6	7,198.5						
Space Station	1,900.0	2,028.9		2,426.0		2,790.8		
Space Transportation Capability Dev.	602.5	879.8	629.8	999.8	724.8	997.4	722.4	
Upper Stages	82.2	108.5	(-20)					Consideration of New Launch Sys Deferred to a later date
Spacelab	129.3	150.2	(-10)					Defer Centaur funding pending DOD negotiation
Engineering & Technical Base	208.5	235.2	(-15)					Defer some hardware replacement
Payload Operations & Supp. Equip.	101.5	144.5	(-15)					Slow rate of growth
Tethered Satellite System	21.9	12.6						Defer some Space Station support
Advanced Programs	35.2	53.8	(-15)					
New Launch System	23.9	175.0						Defer increased emphasis on personnel transportation system
Space Science and Applications	2,429.6	2,934.6						
Physics and Astronomy	975.1	1,140.6	1,096.6	1,321.4	1,241.4	1,308.5	1,248.5	
Gamma Ray Observatory Dev.	22.0	0.0						
Advanced X-Ray Astrophysics Fac.	101.2	211.0	(-50)		(-80)		(-60)	
Global Geospace Science	96.6	65.3						Slow rate of growth for S/C & Mirror funding
Shuttle/Spacelab Payload Mission Mgmt	88.8	88.0						
Space Station Utilization	3.0	0.0						
Payload & Instrument Dev.	94.6	115.9	(+6)					
Explorer Development	99.8	107.9						Develop fit opportunities for deleted Station attached payloads
Mission Operation & Data Analysis	313.3	388.4						
Research & Analysis	100.8	103.1						
Suborbital Program	55.0	61.0						
Life Sciences	138.0	183.9	183.9	284.0	224.0	326.1	246.1	
Human Space Flight & System Eng.	81.1	89.7						
Research & Analysis	56.9	79.2						$2 million earmarked for coop activities on Mir
Lifesat	(2.0)	15.0			(-60)		(-80)	
Planetary Exploration	457.1	627.3	299.3	635.3	251.9	643.5	263.4	Reduce growth rate in out-years
Ulysses Development	3.0	0.0						
Mars Observer	78.5	54.4						
Mars Balloon Relay Experiment	1.5	1.2						
CRAF/Cassini	145.0	328.0	[328.0]		[383.4]		[380.1]	CRAF/Cassini previously authorized in P.L. 101-611
Mission Operations & Data Anlaysis	161.2	150.5						
Research & Analysis	67.9	93.2						
Space Applications	859.4	982.8						
Earth Science & Applications	667.9	775.6	725.6	1,108.0	830.0	1,562.5	950.5	
Earth Observing System	191.0	336.0	(-75)		(-278)		(-612)	
Earth Probes	54.7	68.2	(+15)					Defer some increase pending technical review
Remotely Piloted Aircraft	0.0	5.0						Increase emphasis on this program
Upper Atmosphere Research Satellite	64.0	18.2						
Ocean Topography Experiment	76.0	51.9						
Payload & Instrument Development	49.7	48.6						
Missions Operations & Data Analysis	39.4	56.3	(+5)					
Research & Analysis	193.1	191.4	(+5)					$4 million for activity deferred from '91; $1 million to convert classified remote sensing data
Materials Processing	102.3	125.8	115.8	201.4	201.4	233.6	233.6	$5 million for purchase of Landsat data
			(-10)					Transfer $6 million to Physics/Astronomy Payload & Instrument Development; $4 million gereral reduction
Communications	52.5	39.4	39.4	34.7	34.7	31.1	31.1	
Information Systems	36.7	42.0	42.0	0.0	0.0	0.0	0.0	Out year activities absorbed by other accounts

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
BUDGET SUMMARY
In Millions of Dollars

	FY 1991	FY 1992 AUTHORIZATION		FY 1993 AUTHORIZATION		FY 1994 AUTHORIZATION		
	Approp	Pres Bgt	House Auth	Pres Est	House Auth	Pres Est	House Auth	Comments
Commercial Programs	86.0	150.0						
Technology Utilization	24.4	32.0	27.0 (-5)	31.7	29.7 (-2)	33.0	33.0	
Commercial Use of Space	61.6	118.0	95.0 (-23)	144.2	132.2 (-12)	137.4	130.4 (-7)	General reduction to reduce rate of growth
Aeronautical Research and Technology	512.0	591.2	T&C	670.5	T&C	716.0	T&C	General reduction to reduce rate of growth
Transatmospheric Res. & Tech. (NASP)	95.0	72.0	T&C	120.0	T&C	145.0	T&C	
Space Research & Technology	(255.9)	(354.8)	324.8	321.7	351.7	317.2	367.2	
Research & Technology Base	125.7	141.6	(+10)		(+30)		(+50)	
In-Space Flight Experiments	11.2	16.0						Establish commercial ELV R&D initiative
Civil Space Technology Initiative	119.0	114.3						
Space Automation & Telerobotics	(22.2)	82.9	(-40)					
Exploration Activities	(34.5)	(67.0)	61.0 (-6)	88.0	88.0	102.4	102.4	Delete FTS & restructure AAT program
Exploration Technology	27.5	52.0						General reduction
Exploration Mission Studies	7.0	15.0						
Safety, Reliability & Qual. Assurance	33.0	33.6	33.6	32.5	32.5	34.0	34.0	
Academic Programs	55.1	64.6	64.6	70.5	70.5	74.5	74.5	
Tracking & Data Advanced Systems	20.0	22.0	22.0	23.2	23.2	24.6	24.6	
SPACE FLIGHT, CONTROL & DATA COM.	5,124.4	5,608.3						
Shuttle Production & Ops. Cap.	1,276.4	1,288.9	1,358.9	1,277.0	1,277.0	1,210.5	1,210.5	
Orbiter Operational Capability	275.6	273.8	(+30)					
Propulsion Systems	747.8	622.7	(+50)					Additional support for Orbiter production line
Launch & Mission Support	253.0	270.1						Xfer from CofF; ASRM authorized at $375 million for '92
Assured Shuttle Availability	0.0	122.3	(-10)					
Space Shuttle Operations	2,798.0	3,023.6	2,979.6	3,059.8	2,968.8	3,161.2	2,897.2	Defer Multifunction Electronic Display System
			(-14;-30)		(-46;-45)		(-73;-191)	Delete FTS flt in 94, Flt Oppty & AFE flt in 95; Anticipate Shuttle efficiency of 4% per year
Flight Operations	881.5	912.5						
Flight Hardware	1,393.3	1,617.0						
Launch and Landing Operations	595.2	694.1						
Expendable Launch Vehicles	229.2	341.9	317.9 (-24)	281.0	259.0 (-22)	315.8	309.8 (-6)	Delete NASA funding for MSAT launch vehicle
Space & Ground Networks, Com.	838.8	953.9	920.9 (-33)	1,066.8	1,066.8	1,077.5	1,077.5	General reduction
Space Network	310.1	348.8						
Ground Network	260.7	291.7						
Communications & Data Systems	258.0	314.2						
CONSTRUCTION OF FACILITIES	497.9	480.3	430.3 (-50)	469.8		541.6		Xfer ASRM equipment to ASRM R&D account
RESEARCH AND PROGRAM MANAGEMENT	2,211.9	2,452.3	2,422.3 (-30)	2,492.6		2,495.4		General reduction
INSPECTOR GENERAL	10.5	14.6	14.6	15.3	15.3	15.7	15.7	
TOTAL	13,868.3	15,754.0	12,195.9	17,176.4	9,822.1	18,795.3	9,972.4	

OPENING REMARKS FOR MARK UP

BY

RALPH HALL

Today the Subcommittee meets to begin mark up of the NASA bill for fiscal year 1992. As has been the practice in the past, we are also providing budget authority for fiscal years 1993 and 1994 for all on going programs.

As my colleagues know, we have tried to move quickly this year to develop a bill and bring it to the Floor in order to keep our place in the budgetary process. We have had to deal with many uncertainties in taking this approach. The Space Station restructuring plan has been late, the formal plan for the New Launch System is still being developed, and the Earth Observing System is still under review. In addition, the report of the Stafford Synthesis Group is still in preparation.

Despite these uncertainties, there is great merit in moving forward in order to make sure that our priorities and viewpoints on these issues are considered in the process.

We have made a number of changes to the Administration's request in the Committee print. As always, this Subcommittee would prefer to provide as much funding as possible for the space program. Indeed the Administration's request this year is, by any measure, a reasonable and moderate one and merits full funding. However, it is also clear that the current budgetary environment will not allow full funding of the request. We are all aware of the constraints that are going to be

imposed.

Therefore, in order to bring the NASA bill into line with overall budget realities, we have found it necessary to identify reductions in many areas. The net result is a bill which provides the minimum necessary to sustain a healthy space program. Any further reductions would, I believe, be counter to the best interests of the space program. Despite the need to make these reductions, there is also a need to identify areas which require additional funding.

One of these areas is the ASRM which has been the subject of much debate here on the Subcommittee. Some believe we need the ASRM and it is essential to Station deployment, while others have argued that it is not needed and we should put our resources toward other safety and performance improvements. Unfortunately, the budget we received from the Administration was the worst of all worlds--it contained only half the funding needed to make the program successful. The decision we need to make today is either full funding or no funding. The Committee print contains full funding.

There are several other program augmentations shown in the spread sheet which are very meritorious and can be discussed if anyone desires. A full explanation is contained in the draft report language.

Today, we intend to complete mark up on all portions of the bill except the Space Station and the New Launch System. These will be considered following the hearing which we will hold tomorrow. Without objection then, we will proceed with the bill by section.

I look forward to a successful conclusion to today's meeting and completion of the mark up tomorrow. I would now like to turn to the ranking Republican, Mr. Sensenbrenner for any comments he might have.

Mr. SENSENBRENNER. Thank you very much, Mr. Chairman.

If today's markup will be remembered in the history of the subcommittee, given the early hour we are meeting, it will be remembered as the markup when this subcommittee asserted its legal and political authority to set priorities for NASA at a time of certain budgetary restraint.

In the past we have asserted ourselves as advocates of the programs and missions of NASA and honored the President's request without regard to partisanship. That advocacy role has not changed, but in this budget climate we can only strengthen our support for NASA's work by identifying the least harmful reductions possible.

If we do our job right, NASA will still experience a 10 percent increase in its budget authority. I would like to congratulate you, Mr. Chairman, and Chairman Brown for the leadership and skill demonstrated by the well-formulated authorization proposal before us.

Mr. Chairman, I would ask unanimous consent that the subcommittee print and spreadsheet be used for purposes of markup.

[The prepared opening statement of Mr. Sensenbrenner follows:]

OPENING STATEMENT
BY
HONORABLE F. JAMES SENSENBRENNER, JR.

SUBCOMMITTEE MARKUP
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MULTIYEAR AUTHORIZATION ACT OF 1991
APRIL 10, 1991

Mr. Chairman: If today's markup will be remembered in the history of the Subcommmittee, given the early hour we are meeting, it will be remembered as the markup when this Subcommittee asserted its legal and political authority to set priorities for NASA at a time of certain budgetary restraint.

In the past, we have asserted ourselves as advocates of the programs and missions of NASA and honored the President's request without regard to partisanship. That advocacy role has not changed, but in this budget climate we can only strengthen our support for NASA's work by identifying the least harmful reductions possible.

If we do our job right, NASA will still experience a ten-percent increase in budget authority. I would like to congratulate you, Mr. Chairman and Chairman Brown for the leadership and skill demonstrated by the well-formulated authorization proposal before us.

Mr. Chairman, I move for unanimous consent that the Committee Print and Spread Sheet presented be adopted for purposes of markup.

Mr. HALL. Without objection it is ordered.

Are there other opening statements? Mr. Packard.

Mr. PACKARD. Thank you, Mr. Chairman. I do have an opening statement but I will just enter it in the record so that we can proceed.

[The prepared opening statement of Mr. Packard follows:]

OPENING STATEMENT
OF THE
HONORABLE RON PACKARD (R-CA)
MARK-UP OF THE NASA MULTIYEAR
AUTHORIZATION ACT OF 1991
8:00 -- 11:00 A.M., 2318 RHOB
APRIL 10, 1991

THANK YOU, MR. CHAIRMAN.

TODAY WE MEET TO MARK UP A VERY IMPORTANT PIECE OF LEGISLATION -- THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION ACT OF 1991. WITH THE PUBLICATION OF THE REPORT OF THE ADVISORY COMMITTEE ON THE FUTURE OF THE U.S. SPACE PROGRAM, WE FIND OURSELVES AT A CRITICAL JUNCTURE. THE U.S. SPACE PROGRAM HAS LACKED A DEFINITE VISION OF THE FUTURE EVER SINCE THE APOLLO PROGRAM. IT IS TIME FOR A STRONG CONSENSUS ON THE LONG RANGE GOALS OF THE U.S. SPACE PROGRAM.

KEY TO THIS PROGRAM WILL BE AN ENDURING SPACE INFRASTRUCTURE THAT WILL PROVIDE FOR HUMAN EXPLORATION OF SPACE, THE MONITORING OF THE EARTH'S ENVIRONMENT AND THE FURTHER COMMERCIALIZATION OF SPACE LAUNCHES. FOR THESE INITIATIVES TO MOVE FORWARD A STABLE BUDGET IS NECESSARY. WHILE I MAY NOT SUPPORT EVERY INCREASE, I DO UNDERSTAND THE IMPORTANCE OF UNITING BEHIND A SOLID, GOAL-ORIENTED NASA BILL.

Mr. HALL. Mr. Henry.

Mr. HENRY. Mr. Chairman, just a point of inquiry.

Having several amendments drafted, in sections 2 and 4—I would like to protect the right to offer those until the amendments are typed up.

Mr. HALL. Well, logically, we would like to get the sections and have the amendments and get them behind us.

Mr. HENRY. I understand that.

Mr. HALL. We would like to cooperate with you. Can we drag our feet a little on section 1, and will you have section 2 ready, maybe, by then?

Mr. HENRY. It's just one "sense amendment," so it's coming.

Mr. HALL. It's just a small amendment that makes a lot of sense? [Laughter.]

Mr. Bacchus.

Mr. BACCHUS. Mr. Chairman, in the interests of time, I have no opening statement. I want to commend you for getting us all out here this early, ready to go to work.

Mr. HALL. A full day's work. Election year is just around the corner.

Mr. Cramer.

Mr. CRAMER. Mr. Chairman, I also have no opening statement. Thank you.

[The prepared opening statement of Mr. Cramer follows:]

STATEMENT OF HON. BUD CRAMER

SCIENCE, SPACE AND TECHNOLOGY
SPACE SUBCOMMITTEE
NASA AUTHORIZATION MARKUP
APRIL 10, 1991

MR. CHAIRMAN, I AM A STRONG SUPPORTER OF THE ADVANCED SOLID ROCKET MOTOR PROGRAM. THE ASRM WILL IMPROVE THE SAFETY AND RELIABILITY OF THE PRESENT SYSTEM AND WILL SIGNIFICANTLY INCREASE THE LIFT CAPABILITY OF THE SPACE SHUTTLE. THE ASRM WAS DESIGNED AND SCHEDULED TO SUPPORT THE DEPLOYMENT OF SPACE STATION FREEDOM BY THE 6th DEPLOYMENT FLIGHT OF THE SHUTTLE.

THE REQUESTED FUNDING FOR ASRM WAS INADEQUATE TO SUPPORT SPACE STATION DEPLOYMENT. THE CHAIRMAN HAS RESTORED THE ASRM PROGRAM TO A LEVEL OF FUNDING THAT IS SUFFICIENT TO ALLOW THE ASRM TO PERFORM ON SCHEDULE. I WANT TO TAKE THIS OPPORTUNITY TO THANK THE CHAIRMAN FOR HIS VISION FOR THE FUTURE OF THE SPACE STATION THROUGH HIS COMPLETE SUPPORT FOR THE ASRM PROGRAM WHICH IS SO IMPORTANT TO THE STATION'S TIMELY DEPLOYMENT. I WOULD ALSO LIKE TO THANK AND THE SUBCOMMITTEE STAFF FOR HELPING ME WITH THIS ISSUE.

I FULLY SUPPORT THE LEVEL OF FUNDING FOR THE ASRM PROGRAM CONTAINED IN THE CHAIRMAN'S PROPOSED BILL AND URGE MY COLLEAGUES TO SUPPORT IT AS WELL. THANK YOU MR. CHAIRMAN.

Mr. HALL. Mr. Smith.

Mr. SMITH. No, Mr. Chairman.

Mr. HALL. The gentleman from California?

Mr. ROHRABACHER. Nothing, Mr. Chairman.

Mr. HALL. I can't believe the gentleman from California doesn't have some words for us. [Laughter.]

Mr. Zimmer—Mr. McMillen? The Chair recognizes Mr. McMillen.

Mr. MCMILLEN. I don't have an opening statement, Mr. Chairman, just good morning.

Mr. HALL. Thank you, sir.

All right. Let's go to section 1. Do any members desire to have any detailed discussion on any particular part of section 1?

[No response.]

Mr. HALL. All right, let's have some discussion of the bill. The Chair at this time will recognize anyone who wants to discuss section 1 of the bill. Is there discussion?

[No response.]

Mr. HALL. Is the amendment ready?

Mr. SENSENBRENNER. Mr. Chairman, I move to strike the last word, and ask the gentleman from Michigan whether he is ready to talk about section 2.

Mr. HENRY. I thank my ranking member. Yes, it's being copied right now. It's very simple.

Mr. SENSENBRENNER. Mr. Chairman, I yield back the balance of my time on section 1. [Laughter.]

Mr. HALL. We might discuss any part of the entire markup at this time. Section 1 is not going to cause all that fume and fire and powder.

Mr. SENSENBRENNER. Mr. Chairman, I would ask unanimous consent that the bill be open for amendment at any point. That way, Mr. Rohrabacher and I can dispose of our amendments while Mr. Henry's typist is working, and we can get back to section 2 when they're done.

Mr. HALL. Would you relegate that to any point today?

Mr. SENSENBRENNER. Any point today.

Mr. HALL. All right. Is there objection?

[No response.]

Mr. HALL. The Chair hears none. So ordered.

Mr. ROHRABACHER. Mr. Chairman, the amendment I am offering today is quite simple and primarily symbolic in its significance. It renames the authorization line item previously called "Expendable Launch Vehicles and Services" as simply "Launch Services." The Launch Services Purchase Act of 1990 now requires NASA to purchase the launch services they need, and requires NASA not to purchase any additional vehicles. The few narrowly-drawn exceptions essentially apply only to the Space Shuttle.

My understanding is that NASA is complying with this law, and therefore does not intend to purchase any launch vehicles during the three fiscal years covered by this bill. There is no need, then, to send out a contradictory signal by authorizing a line item for buying ELVs that NASA isn't supposed to buy.

As you can see, we just change it to make it more definitive as to what the law is now, as NASA is going to be purchasing launch

services instead of purchasing expendable launch vehicles and services.

So I would move, on page 9, line 4, to strike "Expendable Launch Vehicles and Services" and insert "Launch Services."

[The amendment offered by Mr. Rohrabacher follows:]

AMENDMENT BY MR. ROHRABACHER OF CALIFORNIA

On page 9, line 4, strike "Expendable Launch Vehicles and Services" and insert "Launch Services".

Mr. HALL. Is there discussion?

[No response.]

Mr. HALL. Let me ask the gentleman from California, does the intent of your amendment preclude NASA from buying vehicles when services are not available?

Mr. ROHRABACHER. I think the intent is basically to be consistent with the Launch Services Purchase Act of 1990. And to the degree that they are not permitted to buy ELVs and launch vehicles by that act, they should not be—they should not be purchasing those launch vehicles, but instead should be purchasing services. But where they are permitted, within the exceptions within that bill, certainly this does not prohibit them, from doing so.

Mr. HALL. The "not reasonably available" exception, you are preserving that?

Mr. ROHRABACHER. Yes.

Mr. HALL. All right.

Is there other discussion?

[No response.]

Mr. HALL. Does anyone else care to be heard?

[No response.]

Mr. HALL. Do you move your amendment?

Mr. ROHRABACHER. I move it.

I move that on page 9, line 4, to strike "Expendable Launch Vehicles and Services" and insert "Launch Services."

Mr. HALL. Is there objection?

[No response.]

Mr. HALL. The Chair hears none. The amendment is adopted.

Mr. SENSENBRENNER. Mr. Chairman, I have Amendment No. 6 at the desk.

Mr. HALL. The Clerk will read the amendment.

Mr. SENSENBRENNER. Mr. Chairman, I ask unanimous consent that the amendment be considered as read and open for amendment at any point.

Mr. HALL. Without objection.

Mr. SENSENBRENNER. Mr. Chairman, this amendment proposes to add a new section on multi-year contracting at the end of the bill that requires the Administrator of NASA, at the time of submission of the fiscal year 1993 budget request next year, to present a study which assesses the usefulness of multi-year contracting for large capital expenditures of NASA.

It is the intent of this amendment to try to get NASA to talk about utilizing the same procedure that the Department of Defense utilizes in contracting for major defense procurement items.

One of the ways that I believe we waste money here in Congress is by limiting NASA to one year's budget authority at a time and one year's appropriations at a time. As a result, the funding of projects that last more than one year comes on up for debate, discussion, and usually modification after a program has been initially authorized.

This type of yo-yoing around with the funding ends up costing the taxpayers more money than it should. We don't require the Defense Department to come back to the Congress every year for more money for an aircraft carrier that the Navy is building, or more money for a new warplane that the Department of the Air

Force wishes to procure. When Congress gives the go-ahead, it authorizes a sum of money over several fiscal years and appropriates, hopefully, the same amount of money over several fiscal years so that the contract can be completed.

We ought to do the same with major items that NASA procures. I think that this will result in an overall saving of the total cost of what NASA procures, so I would urge the adoption of this amendment, and hopefully we could get some better budgeting procedure and save the taxpayers some money in the end.

[Amendment No. 6, offered by Mr. Sensenbrenner, follows:]

Amendment _____

AMENDMENT TO THE SUBCOMMITTEE PRINT

OFFERED BY MR. SENSENBRENNER

Page 20, after line 15, insert the following new section:

SEC. 14. MULTIYEAR CONTRACTING.

Along with submission to Congress of the National Aeronautics and Space Administration fiscal year 1993 budget request, the Adminstrator shall:

(1.) present a study which assesses the usefulness of granting similar authority as under section 2306 (h) of title 10, United States Code, to the National Aeronautics and Space Administration; and

(2.) recommend no less than 5 candidate programs to be considered for by Congress multiyear contracting.

Mr. HALL. Is there other discussion?

[No response.]

Mr. HALL. Do other members have any questions or discussion?

[No response.]

Mr. HALL. I think it's a very good idea, if we can get Appropriations to go along with us. This hasn't been possible in the past, but nothing attempted, nothing gained.

Mr. SENSENBRENNER. I move the adoption of the amendment.

Mr. HALL. Is there objection?

[No response.]

Mr. HALL. The Chair hears none. The motion is adopted.

I think I have Amendment No. 1 there. I am amending three different sections. I would ask unanimous consent to offer up this amendment at this time.

In the past, we have had the opportunity to reconsider several of the proposed reductions in NASA's budget, and by and large some of these, I think, appear very reasonable. In the commercial use of space, if you will notice on the worksheet, we had suggested a $23 million lessening.

Let me ask, do all the members have this worksheet?

[Chorus of yes.]

Mr. HALL. It's the third line on page 2, where we had recommended a $23 million lessening. I am suggesting that we cut $12 million and not $23 million. Actually, there are 16 centers for commercial development—we are dealing with the commercial development of space—there are 16 centers all around the country that will soon be needing to fly commercial experiments, and although there is clearly a need to plan NASA's budget increases in maybe a more prudent manner, we are still very strongly supportive of the commercial programs. I wouldn't want to undercut their efforts, because these people have put up-front money.

I am suggesting that we cut from the Expendable Launch Vehicles, instead of $24 million—that's down on line 6, under Space Shuttle Operations—that we take $36 million there and that would offset this, so there would be no increase. We take out $12 million from Expendable Launch Vehicles to offset this.

So my amendment would partially restore some proposed reductions, and the reduction to the Commercial Use of Space is now only on the order of about 10 percent. I think NASA can absorb this without putting these companies out of business.

[Amendment No. 1 offered by Mr. Hall follows:]

AMENDMENT BY RALPH HALL

COMMERCIAL USE OF SPACE

(en bloc amendments)

On page 7, line 8, strike "$95,000,000" and insert in lieu thereof "$107,000,000"

On page 7, line 9, strike "$132,200,000" and insert in lieu thereof "$138,200,000"

On page 7, line 10, strike "$130,400,000" and insert in lieu thereof "$134,400,000"

On page 9, line 5, strike "$317,900,000" and insert in lieu thereof "$305,900,000"

Mr. HALL. I recognize any other member for questions.

[No response.]

Mr. HALL. If none, I move the adoption of the amendment. Is there objection?

[No response.]

Mr. HALL. The Chair hears none and the amendment is adopted.

Mr. Henry, are you ready?

Mr. HENRY. Thank you, Mr. Chairman, for your understanding.

Mr. HALL. The Chair recognizes you at this time.

Mr. HENRY. I would ask staff to distribute the second amendment, as well.

The first amendment deals with section 2, page 2, lines 10 through 13. It would simply delete one section of the findings. Let me explain the reason I offer the amendment.

I understand why the language was there. In fact, I am sympathetic to the putting of the language in the bill. However, it seems to me to be a bad precedent that, quite frankly, doesn't bear a good deal of logic in simply saying "the budget of NASA should continue to increase toward a goal of 4/10ths of 1 percent of the GNP." In setting NASA spending in relationship to GNP growth or diminishment as opposed to national interest and the character of the science we are pursuing. It just seems to me that it is reckless language. I understand why it is there. I don't like offering the amendment because I support the impetus behind it, but I think it is very reckless language, and I simply submit the amendment.

[The first amendment offered by Mr. Henry follows:]

Amendment offered by Mr. Henry

On page 2, strike lines 10 through 13, and renumber the following subsections accordingly.

Mr. HALL. Are there questions? Does anybody want to be recognized?

[No response.]

Mr. HALL. Let me ask you, do you have an offsetting provision in your amendment as to where the money comes from?

Mr. HENRY. I beg your pardon, Mr. Chairman? I'm deleting the language which simply calls for the NASA budget to grow in relation to GNP. Just simply a finding.

Mr. HALL. All right. Yours is a sense of Congress deletion?

Mr. HENRY. That is correct.

Mr. HALL. All right.

Do we have any discussion on it?

[No response.]

Mr. HALL. Do I hear a motion?

Mr. HENRY. So moved.

Mr. HALL. Is there objection?

[No response.]

Mr. HALL. The Chair hears none. It is adopted.

Mr. HENRY. Thank you.

Mr. Chairman, I have a second amendment. It is in section 4, on page 6. I believe the amendment has been distributed.

It simply rectifies the cuts in the Advanced X-ray Astrophysics Facility. By way of background to the members on the committee, my understanding is that the cuts were recommended by staff in this draft out of concerns that in a January report, in the biannual report of the lenses involved in this facility, some questions had been raised basically of what we have learned from the Hubble experience. The decision was made a year ago to hold back on funding for the X-ray Facility's deployment until the mirrors and the technology had been, in fact, thoroughly tested and certified, and that is obviously a very appropriate thing to do.

My understanding, however, is that the questions that were raised in the January report have been addressed. It is also my understanding that staff was of the opinion that they had not been, and there is apparently some dispute as to that fact.

Given that, it seems to me appropriate that the money ought to be put back in, and then I would be the first to offer an amendment to restore it to the committee recommendations if in fact the information I have is inaccurate.

The other possibility would be simply to say that I raise the question, and suggest approaching it another way. If in fact the issue has been addressed, a spreadout in funding then would be very dysfunctional in terms of carrying through on this facility without needless operation because of reductions in funds, that the chairman would support me in restoration of the funds before the full committee.

Either way, what I'm saying is, let's get the staff on both sides to sit down with the contractors, with NASA, and see whether or not we are acting on misinformation. I am willing to pursue it either way, Mr. Chairman, whichever way you think would facilitate consideration.

Mr. HALL. Are you suggesting that you pull the amendment down and we take a look at it in the full committee?

Mr. HENRY. Yes—either way. What I'm saying is put the money in, and then I would offer an amendment to take it out in the full committee if we weren't satisfied that this issue has been resolved, or else solicit your support for putting the money in at the full committee if in fact we become satisfied that the issue has been addressed.

Mr. SENSENBRENNER. Would the gentleman from Michigan yield?

Mr. HENRY. Yes, I do.

Mr. SENSENBRENNER. The gentleman from Michigan is proposing a $190 million add-on, split $50 million in fiscal year 1992, $80 million in fiscal year 1993, and $60 million in fiscal year 1994.

My concern, aside from the concerns that were expressed both by the chairman and the gentleman from Michigan, is that we're having an add-on here without a comparable offset. Once we start going down that road, then this bill will come out of committee looking like a shopping list for Christmas, rather than setting priorities.

I would urge the gentleman from Michigan to withdraw his amendment. I certainly would like to pursue whether the science will be available for the efficient utilization of this funding between now and the full committee markup, but I do think that if we're going to spend $190 million more, we ought not bust the budget and we ought to figure out where this money is going to come from.

Mr. HALL. Would the gentleman yield?

Mr. SENSENBRENNER. I'd be pleased to yield.

Mr. HALL. I surely agree with Mr. Sensenbrenner. Previous spacecraft programs have sometimes tried to move a little too rapidly, such as the Hubble, in the face of some technical problems. We are trying to get to the bottom, to the basis, and we may have those answers by the time we get to full committee. If we have those answers and they do indicate that some of these problems have been resolved, then we can take a second look at it.

Is that agreeable?

Mr. HENRY. Yes, it is agreeable, Mr. Chairman.

I do want to point out, in answer to the gentleman from Wisconsin, that at the same time we may, in fact, be inappropriately reducing funding—stretching funding, is what it really amounts to—in a way which in fact would add costs to the program by interrupting a program that is proceeding very smoothly.

We are also taking new initiatives. It would be better, it seems to me, to see one program through if in fact it is proceeding smoothly and technologically meeting all of our program requirements, rather than spreading it out and adding others in the same section.

As long as the chairman assures me that we will review this question by the full committee, I withdraw my amendment. Thank you.

Mr. HALL. And we will have more information then, hopefully. I thank the gentleman.

Are there other amendments?

[No response.]

Mr. HALL. Then we will move on to section—that's it?

Dr. SMITH. Yes, Mr. Chairman. We can adopt the bill as is, and then move to report language.

Mr. SENSENBRENNER. Mr. Chairman, I move that those sections of the bill that have been under discussion today be adopted and recommended to the full committee for approval.

Mr. HALL. Is there objection?

[No response.]

Mr. HALL. The Chair hears none.

Anyone else have anything for the good of the committee? Does this evidence that we work better and more rapidly when we meet early in the morning? [Laughter.]

Mr. SMITH. Mr. Chairman.

Mr. HALL. Yes, Mr. Smith.

Mr. SMITH. Mr. Chairman, is it appropriate to offer report language suggestions at this point?

Mr. HALL. Yes, pertaining to the titles.

Mr. SMITH. Mr. Chairman, in the report language I would like to insert in the draft report, on page 22, under "Cooperative Report of MIR," under the last sentence of the first paragraph, the following language: "As part of this activity, NASA is directed to initiate within 60 days of enactment a National Academy of Sciences study on the utilization of the Soviet Space Station MIR to support near-term United States life sciences research activity. This study shall be completed and presented to Congress within one year after inception of said study."

Mr. Chairman, the current report language directs NASA to study the use of MIR for life sciences in conjunction with the NASA Advisory Council. In order to ensure a thorough examination, I propose also asking the National Academy of Sciences to examine the utility of MIR. The National Academy of Sciences Space Study Board has stated that Space Station Freedom will not allow them to conduct a vigorous life sciences program until well after completion of Space Station Freedom, somewhere around the year 2000. In my judgment, Congress should ask this same committee to examine whether MIR could be useful for conducting valuable near-term life sciences research, and in the process, probably save the United States a lot of time and money.

[The report language proposed by Mr. Smith follows:]

REP. LAMAR SMITH
PROPOSED REPORT LANGUAGE
RE: COOPERATIVE RESEARCH ON MIR

On page 23 of draft report under paragraph entitled "Cooperative Research on Mir," strike the last sentence and insert in lieu thereof the following:

As part of this activity, NASA is directed to initiate, within sixty days of enactment of this Act, a National Academy of Sciences study on the utilization of the Soviet space station Mir to support near-term United States life sciences research activity.

This study shall be completed and reported to Congress within one year after commencement of said study.

Mr. SENSENBRENNER. Mr. Chairman, will the gentleman from Texas yield?

Mr. SMITH. I'd be happy to.

Mr. SENSENBRENNER. I think this is a very constructive amendment to report language, and I hope that it is adopted.

Mr. HALL. Is there objection to adoption of the language?

Mr. VOLKMER. A little discussion, Mr. Chairman.

Is it the vision of the gentleman from Texas that the United States would place astronauts in the Soviet Space Station for purposes of this life sciences research?

Mr. SMITH. Not necessarily at all. The whole idea here is simply to take advantage of some of the knowledge gained by the experiments conducted on MIR to enable that information to help the United States. It's not really dictating any astronauts or cosmonauts or anything else.

Mr. VOLKMER. In other words, we are to work with the Russians and utilize their data that they've already gathered?

Mr. SMITH. Right. It is simply to allow the United States to take advantage of the data that the Soviets may have acquired because of the MIR.

Mr. VOLKMER. Okay.

I have no objection.

Mr. HALL. Other statements or enquiries?

[No response.]

Mr. HALL. The Chair hears none. We will adopt that report language by the gentleman from Texas.

The gentleman from Texas is recognized for further report language.

Mr. SMITH. Thank you, Mr. Chairman.

On page 40 of the draft report, after the last sentence in the paragraph entitled "Synthesis Group," I would like to insert the following language: "The Chairman of the Synthesis Group shall establish from among the membership of the Synthesis Group a core group of advisors to assist in the implementation, by NASA and participating agencies, of the recommendations contained in the official report of the Synthesis Group. Such advisory group shall be provided administrative support by NASA."

Mr. Chairman, the purpose of the Synthesis Group is to present options of how to carry out the Space Exploration Initiative. The group is currently preparing a comprehensive report which they will present to Congress next May, but after issuing the report, the Synthesis Group is scheduled to disband.

The purpose of this report language is to allow the Synthesis Group to continue its participation for another six months and ensure that the recommendations contained in their report will actually be implemented.

The Synthesis Group has done an outstanding job. They represent everything our Space Program should represent in the way of American ingenuity and vitality, and I think the Synthesis Group should continue for at least another six months in order to ensure that their recommendations are carried out.

[The report language offered by Mr. Smith follows:]

REP. LAMAR SMITH
PROPOSED REPORT LANGUAGE
RE: THE SYNTHESIS GROUP

On page 41 of draft report after last sentence in paragraph entitled "Synthesis Group," insert the following:

"The Committee further directs the Administrator, in coordination with the Chairman of the Synthesis group, to establish from among the membership of the Synthesis Group, a core group of advisors to assist in the implementation by NASA and other participating agencies of the recommendations contained in the official report of the Synthesis Group. Such advisory group shall be provided administrative support by NASA."

Mr. HALL. Let me ask you a question, Mr. Smith. That's the Stafford Study?

Mr. SMITH. Yes, it is, Mr. Chairman.

Mr. HALL. And they were to report in April. Are you extending their report time, or are you extending the volume of their study?

Mr. SMITH. Mr. Chairman, the point here is to actually extend their involvement. It will be narrowed down to a core group. There won't be as many people involved, but it basically allows them oversight activity to make sure that their recommendations are implemented.

Mr. HALL. But it's important that we try to hold them as closely to their report time for April?

Mr. SMITH. That's true. It doesn't say anything about the report being delayed. In fact, we would like to get that report as early as possible, either April or May, but it does continue their involvement for another six months.

Mr. HALL. Is there other discussion?

Mr. VOLKMER. I would like to ask a question.

Mr. HALL. The gentleman from Missouri.

Mr. VOLKMER. Are we assuming, then, in adopting this, that every recommendation from the Synthesis Group is a valid and binding one that should be followed by NASA and other Federal agencies without question?

Mr. SMITH. I appreciate the question.

No, not necessarily at all. I'm sure that was the response that you expected, but let me assure you that there is some leeway, there is some openness here for a give and take. It's just to make sure that the report isn't filed in a dusty cabinet and then forgotten.

Mr. VOLKMER. Well, I don't mind—we're still going to go to full committee, but I think this language could be maybe better drafted in light of your last comment, because the way I read this, it's almost a recommendation without seeing this report by this subcommittee, and I suppose by the committee, "to assist in the implementation by NASA and other participating agencies of the recommendations contained in the official report of the Synthesis Group." That doesn't say anything but that we're going to implement them.

Mr. SMITH. What I would like to suggest, if we could go ahead and put this report language in, and then you and I could work on a phrase that could be inserted, "assist in the implementation of the recommendations that are approved by" or "suggested by" Congress, or whatever it might be. But I think that's a minor change, and I certainly agree with the sentiments that you've expressed.

Mr. VOLKMER. I just don't want to put carte blanche approval on a report that I haven't seen yet.

Mr. SMITH. Right. I agree with that statement by my colleague and would be happy to refine this language at his convenience.

Mr. HALL. Would you like to have an opportunity to withdraw your request and let the gentleman from Missouri help you with the grammar on it? [Laughter.]

The motion is made to accept the report language of Mr. Smith. Is there objection?

[No response.]

Mr. HALL. The Chair hears none and it is accepted.

Mr. SENSENBRENNER. Mr. Chairman?

Mr. HALL. The Chair recognizes Mr. Sensenbrenner.

Mr. SENSENBRENNER. Mr. Chairman, since we have discussed report items 9 and 10 and the amendatory process, in the interest of saving time and to prevent repetition, I ask unanimous consent that the language in report language number 9 by Mr. Rohrabacher and number 10 by myself be adopted.

Mr. HALL. Is there objection?

[No response.]

Mr. HALL. The Chair hears none. It is adopted.

Do I hear a motion——

Mr. BROWDER. Mr. Chairman.

Mr. HALL. Yes, the gentleman is recognized for five minutes.

Mr. BROWDER. Mr. Chairman, I hope this is the proper time to make this request.

What I would like to request is the opportunity to offer additional report language at the full committee regarding the Commercial Use of Space, if necessary.

Mr. HALL. I think we've cleared that. There's no problem with that.

Mr. BROWDER. Thank you.

Mr. HALL. Are there any other motions or suggestions?

Mr. SENSENBRENNER. Move we adjourn.

Mr. HALL. It has been moved that we recess until tomorrow, at the end of the hearing, at this same place.

Is there objection?

[No response.]

Mr. HALL. The Chair hears none. We are recessed.

[Whereupon, at 8:47 a.m., the subcommittee recessed, to reconvene on Thursday, April 11, 1991.].

[The final amendments as voted on by Subcommittee members follow:]

FINAL

SUBCOMMITTEE ON SPACE

Markup
Wednesday, April 10, 1991

LIST OF AMENDMENTS IN ORDER OF ADOPTION

1.	Mr. Rohrabacher	Expendable Launch Vehicles and Services Vote: Passed without objection
2.	Mr. Sensenbrenner	Sec. 14, Multiyear Contracting Vote: Passed without objection
3.	Mr. Hall	Commercial Programs Vote: Passed without objection
4.	Mr. Henry	Deletion of finding which calls for NASA budget growth in relation to GNP Vote: Passed without objection

REPORT LANGUAGE TO BE OFFERED AS COMMITTEE VIEWS

5.	Mr. Smith	Cooperative Research on Mir Vote: Passed without objection
6.	Mr. Smith	The Synthesis Group Vote: Passed without objection
7.	Mr. Rohrabacher	Expendable Launch Vehicles and Services Vote: Passed without objection
8.	Mr. Sensenbrenner	Multiyear Contracting Vote: Passed without objection

AMENDMENT BY MR. ROHRABACHER OF CALIFORNIA

On page 9, line 4, strike "Expendable Launch Vehicles and Services" and insert "Launch Services".

Amendment _____

AMENDMENT TO THE SUBCOMMITTEE PRINT

OFFERED BY MR. SENSENBRENNER

Page 20, after line 15, insert the following new section:

SEC. 14. MULTIYEAR CONTRACTING.

Along with submission to Congress of the National Aeronautics and Space Administration fiscal year 1993 budget request, the Adminstrator shall:

(1.) present a study which assesses the usefulness of granting similar authority as under section 2306 (h) of title 10, United States Code, to the National Aeronautics and Space Administration; and

(2.) recommend no less than 5 candidate programs to be considered by Congress for multiyear contracting.

AMENDMENT BY RALPH HALL

COMMERCIAL USE OF SPACE

(en bloc amendments)

On page 7, line 8, strike "$95,000,000" and insert in lieu thereof "$107,000,000"

On page 7, line 9, strike "$132,200,000" and insert in lieu thereof "$138,200,000"

On page 7, line 10, strike "$130,400,000" and insert in lieu thereof "$134,400,000"

On page 9, line 5, strike "$317,900,000" and insert in lieu thereof "$305,900,000"

Amendment offered by Mr. Henry

On page 2, strike lines 10 through 13, and renumber the following subsections accordingly.

REP. LAMAR SMITH
PROPOSED REPORT LANGUAGE
RE: COOPERATIVE RESEARCH ON MIR

On page 23 of draft report under paragraph entitled "Cooperative Research on Mir," strike the last sentence and insert in lieu thereof the following:

As part of this activity, N\SA is directed to initiate, within sixty days of enactment of this Act, a National Academy of Sciences study on the utilization of the Soviet space station Mir to support near-term United States life sciences research activity.

This study shall be completed and reported to Congress within one year after commencement of said study.

REP. LAMAR SMITH
PROPOSED REPORT LANGUAGE
RE: THE SYNTHESIS GROUP

On page 41 of draft report after last sentence in paragraph entitled "Synthesis Group," insert the following:

"The Committee further directs the Administrator, in coordination with the Chairman of the Synthesis group, to establish from among the membership of the Synthesis Group, a core group of advisors to assist in the implementation by NASA and other participating agencies of the recommendations contained in the official report of the Synthesis Group. Such advisory group shall be provided administrative support by NASA."

Report Language Amendment by Congressman Rohrabacher

Strike the heading "EXPENDABLE LAUNCH VEHICLES AND SERVICES" and insert the following heading and paragraph:

LAUNCH SERVICES

Change in Category Name.-- This category, formerly "Expendable Launch Vehicles and Services," has been renamed to reflect the fact that pursuant to the Launch Services Purchase Act of 1990 (Title II of Public Law 101-611) NASA will be relying entirely on outside providers for non-Space Shuttle launches, rather than purchasing additional launch vehicles for its own use.

Amendment _____

AMENDMENT TO THE SUBCOMMITTEE REPORT PRINT

OFFERED BY MR. SENSENBRENNER

On page 55 of the Subcommittee Report Print, insert the following new section:

SECTION 14: MULTIYEAR CONTRACTING

Section 14 requires the NASA Administrator to study the multiyear contracting authority used by the Department of Defense and the potential application of similar authority to NASA contracting. The Committee intends that candidate programs submitted with the study for consideration by Congress be substantive development programs of the agency.

SUBCOMMITTEE MARKUP OF NASA MULTIYEAR AUTHORIZATION BILL OF 1991

THURSDAY, APRIL 11, 1991

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON SPACE,
Washington, DC.

The subcommittee met, pursuant to notice, at 11:28 a.m., in room 2325, Rayburn House Office Building, Hon. Ralph Hall (chairman of the subcommittee) presiding.

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SUBCOMMITTEE PRINT

102D CONGRESS
1ST SESSION

H. R. ____

IN THE HOUSE OF REPRESENTATIVES

Mr. BROWN (for himself and Mr. WALKER) introduced the following bill; which was referred to the Committee on _____

A BILL

To authorize appropriations to the National Aeronautics and Space Administration for research and development, space flight, control, and data communications, construction of facilities, research and program management, and Inspector General, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the ``National Aeronautics and Space Administration Multiyear Authorization Act of 1991.''.

SEC. 2. FINDINGS.

Congress finds that--

(1) the report of the Advisory Committee on the Future of the United States Space Program has provided a framework within which a consensus on the goals of the space program can be developed;

(2) the budget of the National Aeronautics and Space Administration should continue to increase toward a goal of four-tenths of one percent of the Gross National Product by the year 2000;

(3) a balanced civil space science program should be funded at a level of at least 20 percent of the aggregate amount in the budget of the National Aeronautics and Space Administration for ``research and development'' and ``space flight, control, and data communications'';

(4) development of an adequate data base for life sciences in space will be greatly enhanced through closer scientific cooperation with the Soviet Union, including active use of manned Soviet space stations;

(5) the space program can make substantial contributions to health-related research and should be an

integral part of the Nation's health research and development program;

(6) Landsat data and the continuation of the Landsat system beyond Landsat 6 are essential to the Mission to Planet Earth and other long-term environmental research programs;

(7) increased use of defense-related remote sensing data and data technology by civilian agencies and the scientific community can benefit national environmental study and monitoring programs;

(8) the generation of trained scientists and engineers through educational initiatives and academic research programs outside of the National Aeronautics and Space Administration is essential to carrying out a long-term Space Exploration Initiative;

(9) policies which restrict the use of foreign launch capabilities for United States Government satellites should apply only where adequate United States launch capabilities exist;

(10) the aeronautical program contributes to the Nation's technological competitive advantage, and it has been a key factor in maintaining preeminence in aviation over many decades; and

(11) the National Aero Space Plane program can have benefits to the military and civilian aviation programs

from the new and innovative technolgies developed in propulsion systems, aerodynamics, and control systems that could be enormous, especially for high-speed aeronautical and space flight.

SEC. 3. POLICY.

It is the policy of the United States that--

(1) the Administrator of the National Aeronautics and Space Administration, in planning for national programs in environmental study and human space flight and exploration, should ensure the resiliency of the space infrastructure;

(2) a stable and balanced program of civil space science should be planned to minimize future year funding requirements in order to accommodate a steady stream of new initiatives;

(3) any new launch system undertaken or jointly undertaken by the National Aeronautics and Space Administration should be based on defined mission and program requirements or national policies established by Congress;

(4) in fulfilling the mission of the National Aeronautics and Space Administration to improve the usefulness, performance, speed, safety, and efficiency of space vehicles, the Administrator should establish a program of research and development to enhance the

competitiveness and cost effectiveness of commercial expendable launch vehicles; and

(5) the National Aeronautics and Space Administration should promote and support efforts to advance scientific understanding by conducting or otherwise providing for research on environmental problems, including global change, ozone depletion, acid precipitation, deforestation, and smog.

SEC. 4. AUTHORIZATION OF APPROPRIATIONS.

(a) AUTHORIZATIONS.--There are authorized to be appropriated to the National Aeronautics and Space Administration the following amounts:

(1) For ``research and development'', for the following programs:

(A) United States International Space Station Freedom, no funds are authorized herein unless a full report setting forth the cost, configuration, and schedule of the Space Station, and an implementation plan for the conduct of a flight test of the solar dynamic program, is submitted to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate.

(B) Space transportation capability development, $629,800,000 for fiscal year 1992, $724,800,000 for

fiscal year 1993, and $722,400,000 for fiscal year 1994.

(C) Physics and astronomy, $1,096,600,000 for fiscal year 1992, of which $6,000,000 shall be made available for carrying out scientific programs which have otherwise been eliminated from the Space Station, $1,241,400,000 for fiscal year 1993, and $1,248,500,000 for fiscal year 1994.

(D) Life sciences, $183,900,000 for fiscal year 1992, $224,000,000 for fiscal year 1993, and $246,100,000 for fiscal year 1994.

(E) Planetary exploration, $299,300,000 for fiscal year 1992, $251,900,000 for fiscal year 1993, and $263,400,000 for fiscal year 1994.

(F) Earth science and applications, $725,600,000 for fiscal year 1992, of which $5,000,000 shall be made available only for the purchase of Landsat data for global change research, and $1,000,000 shall be made available for remote sensing data conversion, $830,000,000 for fiscal year 1993, and $950,500,000 for fiscal year 1994.

(G) Materials processing in space, $115,800,000 for fiscal year 1992, $201,400,000 for fiscal year 1993, and $233,600,000 for fiscal year 1994.

(H) Communications, $39,400,000 for fiscal year

1992, $34,700,000 for fiscal year 1993, and $31,100,000 for fiscal year 1994.

(I) Information systems, $42,000,000 for fiscal year 1992.

(J) Technology utilization, $27,000,000 for fiscal year 1992, $29,700,000 for fiscal year 1993, and $33,000,000 for fiscal year 1994.

(K) Commercial use of space, $95,000,000 for fiscal year 1992, $132,200,000 for fiscal year 1993, and $130,400,000 for fiscal year 1994.

(L) Aeronautical research and technology, $591,200,000 for fiscal year 1992, $670,500,000 for fiscal year 1993, and $716,000,000 for fiscal year 1994.

(M) Transatmospheric research and technology, $72,000,000 for fiscal year 1992, $120,000,000 for fiscal year 1993, and $145,000,000 for fiscal year 1994.

(N) Space research and technology, $324,800,000 for fiscal year 1992, $351,700,000 for fiscal year 1993, and $367,200,000 for fiscal year 1994. Of such amounts, $10,000,000 in fiscal year 1992, $30,000,000 in fiscal year 1993, and $50,000,000 in fiscal year 1994 shall be made available for carrying out a program of component technology development

directed at commercial expendable launch vehicle competitiveness.

(O) Exploration activities, $61,000,000 for fiscal year 1992, $88,000,000 for fiscal year 1993, and $102,400,000 for fiscal year 1994.

(P) Safety, reliability, and quality assurance, $33,600,000 for fiscal year 1992, $32,500,000 for fiscal year 1993, and $34,000,000 for fiscal year 1994.

(Q) University Space Science and Technology Academic Program, $64,600,000 for fiscal year 1992, $70,500,000 for fiscal year 1993, and $74,500,000 for fiscal year 1994.

(R) Tracking and data advanced systems, $22,000,000 for fiscal year 1992, $23,200,000 for fiscal year 1993, and $24,600,000 for fiscal year 1994.

(2) For ``space flight, control, and data communications'' for the following programs:

(A) Space Shuttle Production and Operational Capability, $1,358,900,000 for fiscal year 1992, of which $375,000,000 shall be made available for the Advanced Solid Rocket Motor program, $1,277,000,000 for fiscal year 1993, and $1,210,500,000 for fiscal year 1994.

BROWCA024

(B) Space Shuttle Operations, $2,970,600,000 for fiscal year 1992, $2,968,800,000 for fiscal year 1993, and $2,897,200,000 for fiscal year 1994.

(C) Expendable Launch Vehicles and Services, $317,900,000 for fiscal year 1992, $259,000,000 for fiscal year 1993, and $309,800,000 for fiscal year 1994.

(D) Space and ground networks, communications, and data systems, $920,873,000 for fiscal year 1992, $1,066,000,000 for fiscal year 1993, and $1,077,500,000 for fiscal year 1994.

(3) For ``construction of facilities'', including land acquisition, for fiscal year 1992 as follows:

(A) Construction of Space Station Processing Facility, Kennedy Space Center, $35,000,000.

(B) Modification for Earthquake Protection, Downey/Palmdale, CA, Johnson Space Center, $4,400,000.

(C) Modifications for Safe Haven, Vehicle Assembly Building, High-Bay 2, Kennedy Space Center, $7,500,000.

(D) Rehabilitation of Crawlerway, Kennedy Space Center, $3,000,000.

(E) Restoration of Shuttle Landing Facility Shoulders, Kennedy Space Center, $4,000,000.

BROWCA024

(F) Restoration of the High Pressure Gas Facility, Stennis Space Center, $6,500,000.

(G) Construction of Addition for Flight Training and Operations, Johnson Space Center, $13,000,000.

(H) Construction of Advanced Solid Rocket Motor Program Facilities (various locations), $100,000,000.

(I) Modernization of Industrial Area Chilled Water System, Kennedy Space Center, $4,000,000.

(J) Rehabilitation and Expansion of Communications Duct Banks, Kennedy Space Center, $1,400,000.

(K) Replace 15 KV Load Break Switches, Kennedy Space Center, $1,300,000.

(L) Repair Site Water System, White Sands Test Facility, $1,300,000.

(M) Replace Central Plant Chillers and Boiler, Johnson Space Center, $5,700,000.

(N) Modifications to X-Ray Calibration Facility (XRCF), Marshall Space Flight Center $5,200,000.

(O) Restoration and Modernization of High Voltage Distribution System, Goddard Space Flight Center, $7,000,000.

(P) Construction of Earth Observing System Data Information System Facility, Goddard Space Flight Center, $17,000,000.

(Q) Modernization of Main Electrical Substation, Jet Propulsion Laboratory, $5,500,000.

(R) Restoration of Utilities, Wallops Flight Facility, $3,500,000.

(S) Construction of Data Interface Facility, White Sands Test Facility, $4,000,000.

(T) Rehabilitation of Tracking and Data Relay Satellite System (TDRSS) Ground Terminal, White Sands Test Facility, $5,700,000.

(U) Repair of facilities at various locations, not to exceed $1,000,000 per project, $31,700,000.

(V) Rehabilitation and modification of facilities at various locations, not to exceed $1,000,000 per project, $34,800,000.

(W) Minor construction of new facilities and additions to existing facilities at various locations, not to exceed $750,000 per project, $12,900,000.

(X) Environmental compliance and restoration, $36,000,000.

(Y) Facility planning and design, not otherwise provided for, $34,000,000.

(Z) Repair and modernization of the 12-foot Pressure Wind Tunnel, Ames Research Center, $25,000,000.

(AA) Upgrade of Outdoor Aerodynamic Research Facility, Ames Research Center, $3,300,000.

(BB) Modernization of 16-foot Transonic Tunnel, Langley Research Center $3,400,000.

(CC) Modifications to the High Pressure Air System, Langley Research Center, $11,700,000.

(DD) Rehabilitation of Central Air System, Lewis Research Center, $5,600,000.

(EE) Rehabilitation of Icing Research Tunnel, Lewis Research Center, $2,600,000.

Notwithstanding the amounts authorized in subparagraphs (A) through (EE), the total amount authorized by this paragraph shall not exceed $430,300,000.

(4) For ``research and program management'', $2,422,300,000 for fiscal year 1992.

(5) For ``Inspector General'', $14,600,000 for fiscal year 1992, $15,300,000 for fiscal year 1993, and $15,700,000 for fiscal year 1994.

(b) LIMITATIONS.--(1)(A) Notwithstanding paragraph (4), appropriations authorized under this section for ``research and development'' and ``space flight, control, and data communications'' may be used--

(i) for any items of a capital nature (other than acquisition of land) which may be required at locations other than installations of the National Aeronautics and

Space Administration for the performance of research and development contracts; and

(ii) for grants to nonprofit institutions of higher education, or to nonprofit organizations whose primary purpose is the conducting of scientific research, for purchase or construction of additional research facilities.

Title to facilities described in clause (ii) shall be vested in the United States unless the Administrator determines that the national program of aeronautical and space activities will best be served by vesting title in any such grantee institution or organization. Each such grant shall be made under such conditions as the Administrator shall determine to be required to ensure that the United States will receive therefrom benefit adequate to justify the making of that grant.

(B) None of the appropriations authorized under this section for ''research and development'' and ''space flight, control, and data communications'' may be used in accordance with this paragraph for the construction of any facility, the estimated cost of which, including collateral equipment, exceeds $750,000, unless the Administrator has notified the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate of the nature, location, and

estimated cost of such facility.

(2) Appropriations authorized under this section for ''research and development'', for ''space flight, control, and data communications'', or for ''construction of facilities'' may remain available until expended. Appropriations authorized under this section for ''research and program management'' for maintenance and operation of facilities, and for other services, shall remain available through the next fiscal year after the fiscal year for which such amount is appropriated.

(3) Not to exceed $35,000 of appropriations authorized under this section for ''research and program management'' may be used for scientific consultations or extraordinary expenses upon the approval or authority of the Administrator, and the Administrator's determination shall be final and conclusive upon the accounting officers of the Government.

(4)(A) Except as provided in paragraph (1)(A), appropriations authorized under this section for ''research and development'', ''space flight, control, and data communications'', or ''research and program management'' may be used for the construction of new facilities and additions to, or repair, rehabilitation, or modification of existing facilities, but only if the cost of each such project, including collateral equipment, does not exceed $200,000.

(B) Except as provided in paragraph (1)(A),

appropriations authorized under this section for ``research and development'' or ``space flight, control, and data communications'' may be used for unforeseen programmatic facility project needs, but only if the cost of each such project need, including collateral equipment, does not exceed $750,000.

(C) Appropriations authorized under this section for ``research and program management'' may be used for repair, rehabilitation, or modification of existing facilities controlled by the General Services Administration, but only if the cost of each such project, including collateral equipment, does not exceed $500,000.

SEC. 5. CONSTRUCTION OF FACILITIES REPROGRAMMING.

Appropriations authorized under section 4(a)(3)(A) through (EE)--

(1) may be varied upward 10 percent, in the discretion of the Administrator or the Administrator's designee; or

(2) following a report by the Administrator or the Administrator's designee to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate on the particular circumstances, may be varied upward 25 percent to meet unusual cost variations.

The total amount of appropriations authorized under section

BROWCA024

4(a)(3)(A) through (EE) shall not be increased as a result of actions taken under paragraphs (1) and (2) of this section.

SEC. 6. SPECIAL REPROGRAMMING AUTHORITY FOR CONSTRUCTION OF FACILITIES.

Where the Administrator determines that new developments or scientific or engineering changes in the national program of aeronautical and space activities have occurred; and that such changes require the use of additional funds for the purposes of construction, expansion, or modification of facilities at any location; and that deferral of such action until the enactment of the next authorization Act would be inconsistent with the interest of the Nation in aeronautical and space activities; the Administrator may transfer not to exceed one-half of 1 percent of the funds appropriated pursuant to section 4(a)(1) or (2) to the ``construction of facilities'' appropriation for such purposes. The Administrator may also use up to $10,000,000 of the amounts authorized under section 4(a)(3) for such purposes. The funds so made available pursuant to this section may be expended to acquire, construct, convert, rehabilitate, or install permanent or temporary public works, including land acquisition, site preparation, appurtenances, utilities, and equipment. No such funds may be obligated until a period of 30 days has passed after the Administrator or the Administrator's designee has transmitted to the Committee on

BROWCA024

Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate a written report describing the nature of the construction, its cost, and the reasons therefor.

SEC. 7. CONSIDERATION BY COMMITTEES.

Notwithstanding any other provision of this Act--

(1) no amount appropriated pursuant to this Act may be used for any program deleted by the Congress from requests of the Administrator as originally made to either the Committee on Science, Space, and Technology of the House of Representatives or the Committee on Commerce, Science, and Transportation of the Senate;

(2) no amount appropriated pursuant to this Act may be used for any program in excess of the amount actually authorized for that particular program by section 4(a)(1), (2), and (4); and

(3) no amount appropriated pursuant to this Act may be used for any program which has not been presented by the Administrator to either such committee,

unless a period of 30 days has passed after the receipt by each such committee of notice given by the Administrator containing a full and complete statement of the action proposed to be taken and the facts and circumstances relied upon in support of such proposed action. The National

Aeronautics and Space Administration shall keep the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate fully and currently informed with respect to all activities and responsibilities within the jurisdiction of those committees. Any Federal department, agency, or independent establishment shall furnish any information requested by either committee relating to any such activity or responsibility.

SEC. 8. SMALL BUSINESS INNOVATION RESEARCH PROGRAM.

The Administrator may utilize up to 5 percent of the funds provided for the Small Business Innovation Research Program pursuant to section 4(f) of the Small Business Innovation Development Act of 1982, for program management and promotional activities.

SEC. 9. OFFICE OF FACILITIES MAINTENANCE.

The Administrator shall create an Office of Facilities Maintenance, which shall have complete authority to plan and direct facilities maintenance management for all National Aeronautics and Space Administration sites.

SEC. 10. COMMERCIAL SPACE LAUNCH ACT AMENDMENT.

Section 24 of the Commercial Space Launch Act (49 U.S.C. App. 2623) is amended by adding at the end thereof the following: ``There are authorized to be appropriated to the Secretary to carry out this Act $5,104,000 for fiscal year

1992.''.

SEC. 11. NATIONAL SPACE COUNCIL AUTHORIZATION.

(a) There are authorized to be appropriated to carry out the activities of the National Space Council established by section 501 of the National Aeronautics and Space Administration Authorization Act, Fiscal Year 1989 (42 U.S.C. 2471), $1,491,000 for fiscal year 1992, of which not more than $1,000 shall be available for official reception and representation expenses. The National Space Council shall reimburse other agencies for not less than one-half of the personnel compensation costs of individuals detailed to it.

(b) It is the sense of Congress that the National Space Council, in coordination with the Committee on Earth and Environmental Sciences, should, by October 1, 1991, establish policy recommendations for carrying out the President's commitment to maintaining the continuity of Landsat data, including plans and programs for a succesor to Landsat 6, organizational options and recommendations for acquiring Landsat data for global change research, national security, environmental management, and other governmental purposes, and options and recommendations for encouraging the use of Landsat data by commercial firms and development of the commercial market for such data.

SEC. 12. OFFICE OF SPACE COMMERCE AUTHORIZATION.

There are authorized to be appropriated to the Secretary

BROWCA024

of Commerce for the Office of Space Commerce $491,000 for fiscal year 1992.

SEC. 13. AMENDMENT OF PUBLIC LAW 100-147.

Section 107(a) of the National Aeronautics and Space Administration Authorization Act of 1988 (P.L. 100-147) is amended--

(1) by inserting ``, in both then year and constant dollars,'' after ``estimated cost'';

(2) by inserting ``assembly (including related costs);'' after ``construction of facilities;''; and

(3) by adding at the end the following new sentence: ``Each such plan shall also include the estimated cost, in both then year and constant dollars, of operations for at least the first full year of steady operations of the space station.''.

April 8, 1991 11:27 AM

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION MULTIYEAR AUTHORIZATION ACT OF 1991

REPORT

CONTENTS

Introduction.....
Purpose of the Bill.....
Legislative Reporting Requirements.....
Explanation of the Bill and Committee Views.....

[to be added]

Sectional Analysis.....
Committee Recommendations.....
Congressional Budget Office--Cost Estimate.....
Effects of Legislation on Inflation.....
Changes in Existing Law Made by the Bill as Reported.....
Oversight Findings and Recommendations.....
Oversight Findings and Recommendations of the Committee on Government Operations.....
Administration Recommendations:
NASA Request.....
DOT Request.....

INTRODUCTION

Over the next decade, the substantive efforts of the space program will be directed toward preparing a space infrastructure to carry out major initiatives in environmental study and human exploration. This infrastructure will include a system of Earth observing platforms together with a data management system, a manned Space Station, and a space transportation system. The Committee's review of the budget request for fiscal year 1992 and succeeding years has been carried out with the intent of ensuring that this infrastructure is resilient and based on a sound long range strategy.

Concurrent with this infrastructure development, NASA intends to execute a science strategic plan made up of large, intermediate, and small missions together with programs designed to utilize and enhance man related elements of the space program. The Committee's efforts have been directed at ensuring the stability of this strategic plan in a budgetary context and its responsiveness to broader scientific needs.

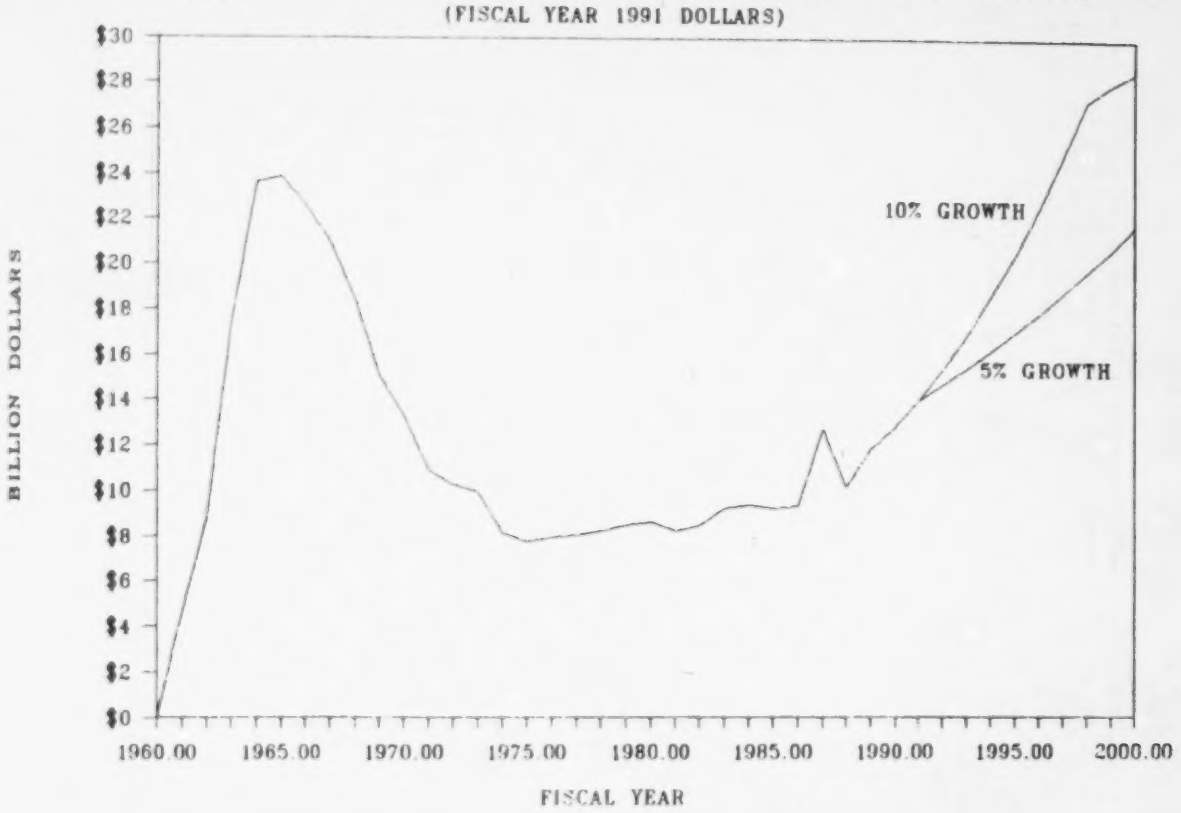
The Committee's consideration of the NASA request this year has also been carried out within the framework of the Report of the Advisory Committee on the Future of the U.S. Space Program. This report has provided a strong basis for developing a consensus on the long range goals and directions for the space program. As established in this report, such a consensus does not now exist and has been lacking since the Apollo program. As a result, the underlying rationale for the space program in the present budgetary, social, and political environment has received no serious consideration in nearly two decades and space policy has largely resulted from specific hardware initiatives and budgetary influences. Thus, ambitious extensions of the space program including renewed human exploration initiatives and major environmental monitoring efforts, should rightfully be reconsidered and based on a full understanding of the contemporary role of science and technology in the National agenda.

Key to sustaining the robust and balanced space program recommended by the Advisory Committee report is a consensus on a long-range stable and increasing budget. The budgetary growth recommended by the Report, an annual increase of 10 percent real growth, will lead to a doubling of the NASA budget before the year 2000 at which time the NASA budget will reach a level of 0.4 percent of the GNP. This approximates the average share of the GNP allocated to the space program during the Apollo era.

[figure 1]

Although this specific budget growth may be difficult to sustain

FIGURE 1. GROWTH ENVELOPE FOR NASA



over a long period, the Committee believes that some such steady commitment of at least half that growth rate is essential to expanding the space program beyond its present dimensions. If such a budget growth does not materialize and the space program remains at or near its present level, the present balance between science and infrastructure development and the long range intent of the manned program will need to be seriously reconsidered.

The Committee has provided a multiyear authorization for NASA's major programs in order to more realistically establish their budgetary requirements and has also developed guidelines in critical policy areas. A summary of major provisions of the bill is as follows:

- Funds for the Space Station and the New Launch System will be added by amendment pending a review of these programs.
- General reductions have been applied in certain Space Transportation Capability Development programs with a view of restoring these funds in future fiscal years as their needs become better defined.
- The rate of increase in funding for spacecraft definition studies and instrument development for the Advanced X-Ray Astrophysics Facility has been slowed pending clearer demonstration of success in mirror metrology.
- Funding has been provided for alternative flight programs for those attached payloads that were deleted from the Station.
- Funding has been provided for life science activities on the Soviet Mir Space Station.
- Funding has been provided for the Lifesat new start, however, program growth in fiscal years 1993 and 1994 has been slowed.
- The rate of increase in funding for the Earth Observing System has been reduced pending completion of the current technical review.
- Funding has been added for Earth probes, classified remote sensing data conversion, and the Earth science data analysis activities which were deferred in fiscal year 1991.
- Funding has been provided for the purchase of Landsat data for Global Change research.
- Funding for Materials Processing in Space has been reduced based on the need to develop alternative flight programs for deleted Station attached payloads and also the need to better define the role of Station materials processing facilities that are scheduled to be delivered after the Permanent Manned Capability milestone, when Life Science activities should predominate.
- The rate of increase in funding for Commercial Use of Space has been reduced without prejudice.
- The rate of increase in funding for Technology Utilization has been reduced.
- A program of component technology development has been established in order to assist the commercial launch vehicle industry.
- In lieu of a Flight Telerobotic Servicer program, an automation and robotics technology program has been established emphasizing

teleoperated Space Station payload technologies and micro rover technologies for planetary exploration.

- A general reduction in Exploration Activities has been made without prejudice. The Committee reaffirms its strong support for a sustained Exploration program.
- Funding has been augmented for the Advanced Solid Rocket Motor program in order to allow it to support the Space Station requirements and schedule.
- Funding has been augmented to maintain an active Shuttle structural spares and Shuttle production support program.
- Work on the "glass cockpit" within the Assured Shuttle Availability Program has been reduced.
- Funding for two future Shuttle flights has been eliminated and one Shuttle flight has been delayed.
- Overall funding for Shuttle Operations has been reduced in anticipation of greater management and program efficiencies.
- Funding for expendable launch vehicle services for MSAT has been deleted pending clearer definition of the role of the MSAT consortium.
- A general reduction has been made to the Space and Ground Networks, Communications, and Data Systems program.
- Funds from the construction of the ASRM facility have been applied to the ASRM development program.
- A general reduction has been made to the Research and Program Management account.
- The sense of Congress has been expressed that the National Space Council should develop policy recommendations for the follow-on program to Landsat 6.

PURPOSE OF THE BILL

The purpose of the bill is to authorize appropriations to the National Aeronautics and Space Administration (NASA) for fiscal years 1992, 1993, and 1994, and to the Department of Transportation Office of Commercial Space Transportation, the Department of Commerce Office of Space Commerce, and the National Space Council within the Executive Office of the President. The bill also sets forth special policy provisions and authorities in order to carry out the activities of the civil space program. In summary, the bill provides the following budget authority:

AMOUNT OF NEW BUDGET AUTHORITY
[Millions of Dollars]

	Fiscal year 1992	Fiscal Year 1993	Fiscal Year 1994
National Aeronautics and Space Administration.....	$12,195.9	$9,822.1	$9,972.4
Department of Transportation Office of Commercial Space Transportation.....	$5.1		
Department of Commerce Office of Space Commerce.....	$0.5		
National Space Council.....	$1.5		

Summary of Committee Views

POLICY

Science Budget "Bow Wave".--The Committee is concerned that the future year budget requirements and projections resulting from the science programs requested in fiscal year 1992 are so large that no budget margin or new starts will be available.

SPACE STATION

Space Station Program Restructuring.--The Committee is concerned that the proposed restructuring of the Space Station will not achieve the original goals of the program.

Program Management.--The Committee is concerned that contemplated management changes may be disruptive and costly unless a clear long range transition plan is developed.

PHYSICS AND ASTRONOMY

Advanced X-Ray Astrophysics Facility (AXAF).--The Committee reduces the rate of increase in AXAF funding.

Deletion of Space Station Attached Payloads.--The Committee regrets NASA's deletion of the attached science payloads from the Space Station program and directs NASA to develop alternative means of conducting the experiments that were deleted.

Astronomy and Astrophysics in the 1990s.--The Committee urges NASA to give serious consideration to the findings and recommendations of the National Academy of Sciences' review of astronomy and astrophysics priorities for the 1990s when the Office of Space Sciences and Applications revises its strategic plan.

LIFE SCIENCES

Lifesat.--The Committee reduces NASA's runout for the Lifesat program and urges NASA to exert strong discipline over program costs.

Cooperative Research on Mir.--The Committee supports cooperative life sciences research on the Soviet space station Mir and directs NASA to provide a plan for such cooperative activities.

PLANETARY EXPLORATION

Comet Rendezvous Asteroid Flyby (CRAF) Program.--The Committee is

concerned about the turbulence in the CRAF program over the past year.

Planetary Exploration and the Proposed Office of Exploration.--The Committee has reservations about the potential transfer of robotic missions from the OSSA to the new office of Exploration and urges the NASA Administrator to formally solicit the views of the scientific community prior to approving such a transfer.

EARTH SCIENCE AND APPLICATIONS

Earth Observing System.--In the absence of the report of the Earth Observing System (EOS) external engineering review and an affordable plan for this program, the Committee has reduced the rate of increase in funding for EOS.

EOS Data and Information System.--The Committee directs NASA to maintain the schedule for the EOSDIS procurement and continue rapid development of EOSDIS Version 0.

Landsat Data Purchase.--The Committee has made $5,000,000 available only for the purchase of Landsat data for the Global Change Research Program, with the intention that NASA and the private operator of Landsat reach a mutual agreement on an equitable and low-cost price for Landsat Thematic Mapper data. The Committee urges NASA to assist in preserving archived Landsat data and to incorporate new and archived data into the EOS Data and Information System.

Earth Probes.--The Committee has augmented the funding for Earth Probes to accelerate the development of the Tropical Rainfall Measurement Mission and to fly the Earth science attached payloads deleted from the space station.

MATERIALS PROCESSING IN SPACE

Reduction in Funding for Space Station Utilization.--The Committee believes that NASA should provide alternative flight opportunities for the physics and astronomy attached payloads that were deleted from the Space Station program.

COMMUNICATIONS

ACTS Experiments Program.--The Committee believes that NASA should maintain adequate funding for an industry experiments program using ACTS notwithstanding contemplated establishment of Centers for the Commercial Development of Space.

INFORMATION SYSTEMS

Preserving Existing Data and Handling New Data.--The Committee urges NASA to devote sufficient resources to preserving data collected over the past 30 years.

TECHNOLOGY UTILIZATION

Reduction in Rate of Funding Increase.--The Committee believes that the technology utilization program can be made more effective within a more modest budget envelope.

COMMERCIAL USE OF SPACE

Budgetary Growth Associated With Flight Programs.--The Committee reaffirms its support for programs to encourage private investment in space activities but believes that budget realities prevent the near doubling of the budget for Commercial Use of Space.

Industry Participation.--The Committee requests a report on plans to increase incentives for the Centers for the Commercial Development of Space (CCDS) to obtain industry cash support, such as a matching fund program, and plans for the periodic recompetition of CCDS contracts.

SPACE RESEARCH AND TECHNOLOGY

Research and Development Support for the Commercial Launch Vehicle Industry.--The Committee continues to urge NASA to take actions to develop and provide new technologies to the commercial launch vehicle industry.

Flight Telerobotic Servicer.--The Committee reduces the funding for the Flight Telerobotic Servicer program in the wake of the transfer of this program out of the Space Station Office.

EXPLORATION ACTIVITIES

SP-100 Reactor Program.--The Committee wishes to be kept informed as to how the exploration-related requirements of the SP-100 program are being addressed.

Synthesis Group.--The Committee notes that the Synthesis Group will be reporting on alternative approaches to human exploration. The Committee requests a report on NASA's response to the Synthesis Group's findings.

ACADEMIC PROGRAMS

Educational Goals of the Human Exporation Program.--The Committee commends the establishment of education as a primary goal of Human Exploration. The Committee believes that a focused program of secondary educational initiatives and direct university and academic programs will be necessary to provide the educated workforce necessary to carry out an aggressive Human Exploration program.

SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY

Orbiter Production Readiness.--The Committee directs NASA to move with all deliberate speed to complete a long-range plan for the Space Shuttle Orbiter production line.

SPACE SHUTTLE OPERATIONS

Cost Savings in the Space Shuttle Program.--The Committee notes the testimony of key NASA officials that significant cost savings could be achieved in the Space Shuttle program without causing a negative impact on quality or safety. The Committee expresses support for such an initiative.

EXPENDABLE LAUNCH VEHICLES AND SERVICES

Deletion of Funding for the MSAT Launch Vehicle.--Given the recent court decision effectively rescinding the license for the American Mobile Satellite Consortium (AMSC), the Committee believes that funding to pay for part of the launch vehicle for AMSC's mobile communications satellite (MSAT) would be premature and that federal agencies should procure MSAT services directly as required.

SPACE AND GROUND NETWORKS, COMMUNICATIONS, AND DATA SYSTEMS

Adequacy of Funding.--The Committee expresses its concern that delaying planned improvements of aging and inefficient equipment may result in greater long-term costs and degradation in NASA's ability to support future flight missions.

Advanced Tracking and Data Relay Satellite.--The Committee views the Advanced TDRS procurement as an opportunity to establish a more cost-effective space network and urges NASA to consider procurement on a fixed-price basis as one potential option.

LEGISLATIVE REPORTING REQUIREMENTS

Reference and Requirement

Section 4--A Life Sciences Plan for Cooperative Research on Mir. Due December 1, 1991.

Section 4--A report on NASA's response to the Findings and Recommendations of the Synthesis Group. Due six months after the release of the Synthesis Group's report.

Section 4--A report on NASA's plans for increasing incentives for Centers for the Commercial Development of Space (CCDS) to obtain industry cash support, NASA's process for reviewing the level of industry support obtained by the centers, and NASA's plans for recompeting the CCDS contracts. Due on November 1, 1991.

Section 4--A report summarizing the progress NASA is making in providing technology support to the commercial launch vehicle industry. The report is due by March 1, 1992.

Section 4--A long-range plan for how to handle the production line for Space Shuttle Orbiters. This plan was originally due to the Committee by March 1, 1990. The committee directs NASA to "move with all deliberate speed" in completing this plan.

Section 4--A report on how NASA will achieve annual cost savings of 3 to 5 percent in the Space Shuttle program. The report is due by March 1. 1992.

EXPLANATION OF THE BILL AND COMMITTEE VIEWS

SECTION 1: SHORT TITLE

Section 1 designates that the act may be cited as the "National Aeronautics and Space Administration Multiyear Authorization Act of 1991."

SECTION 2: FINDINGS

Section 2(1) finds that the report of the Advisory Committee on the Future of the U.S. Space Program, known as the "Augustine report", has provided a framework for developing a consensus on space goals.

Section 2(2) finds that the budget growth recommended by the Augustine report should continue toward the goal of 0.4 percent of the GNP, about half that of the peak funding during the Apollo program.

Section 2(3) finds that a balanced science program should be funded at 20 percent of the non-institutional budget of NASA. This is intended to maintain an overall balance between science and infrastructure development.

Section 2(4) finds that cooperation with the Soviets on the Space Station Mir may enhance the life sciences data base. This finding is based on the foreign policy benefits that may accrue and the overall cost effectiveness of utilizing existing space capabilities, especially in view of the diminishing scope of life sciences intended for the near term on the Space Station Freedom. This finding is not intended to signify any lessening of support for a strong U.S. program of permanent manned presence in space.

Section 2(5) finds that the space program can make substantial contributions to medical and health related research. The intent is to encourage an integrated plan of health research between NASA and other health related research agencies.

Section 2(6) finds that Landsat data are essential to any long term environmental research program such as Mission to Planet Earth. The Committee intends that NASA undertake efforts to integrate Landsat data into the EOS Data and Information System for use by participating researchers.

Section 2(7) finds that heretofore classified remote sensing data may be of use for environmental research programs such as Mission to Planet Earth and Global Change. The Committee intends that NASA undertake a program, in cooperation with Defense and Intelligence agencies, to study ways of utilizing such data without compromising national security.

Section 2(8) finds that the Space Exploration Initiative will depend directly on the generation of trained scientists and engineers. The Committee believes that the successful generation of the necessary trained work force can be accomplished through a balance of societal educational initiatives at the secondary educational level, and also through directly administering related grants and contracts to colleges and universities to employ faculty and students in space exploration research.

Section 2(9) finds that policies which restrict the use of foreign launch vehicles for U.S. government satellites should only apply when adequate U.S. launch capabilities are available. The Committee recognizes that such restrictive policies are intended to provide support for a strong U.S. launch services industry. Indeed, the Committee has provided NASA ample authority in the past to restrict procurement of launch services to domestic sources. However for some satellites, such as the Earth Observing System platform A, the absence of a U.S. launch system with lift capabilities between the Atlas E and Titan IV-class vehicles from the West Coast has resulted in a program which may be overly complex and costly. The Committee strongly feels that adequate launch capabilities out of the West Coast should be established. However, if such is not possible, the intent of this finding is to encourage the seeking of waivers from any such restrictive policies if the application of such policies does not serve the public interest or result in a cost-effective scientific program.

[Technology and Competitiveness Subcommittee findings to be included]

SECTION 3: POLICY

Section 3(1) states the policy that the Administrator should ensure resiliency in the space infrastructure. The Committee intends that this policy result in multiple capabilities for access to space, especially in assembling and servicing the Space Station.

Section 3(2) states the policy that a balanced and stable science program should be planned to minimize future year funding requirements.

Committee view

Science Budget "Bow wave"

The Committee clearly recognizes the great progress that has been made in developing an overall strategic plan for carrying out a balanced space science program. This plan has provided valuable long range planning data on the decisions that can be anticipated in initiating future missions and projects. The report of the Advisory

Committee on the Future of the U.S. Space program has recommended the execution of this strategic plan and, further, established a budgetary context for this plan as a 20 percent share of the overall NASA budget (normally taken to be the non-institutional budget, Research and Development, and Space Flight, Control, and Data Communications).

The Committee endorses these recommendations as a reasonable way of structuring a balanced science program that provides a steady stream of new starts. However, the Committee notes that the fiscal year 1992 request for NASA's overall science program represents an increase over FY 1991 of nearly 21 percent of which less than one percent is attributable to new starts. Furthermore, the funding required in fiscal year 1993 to carry out the programs approved in fiscal year 1992 represents an increase of 22 percent. Thus, the issue arises whether such increases can be expected in the present budgetary environment and, if not, can such a strategic plan be considered sound.

Figure 2 shows a general representation of the budgetary context implied by the Augustine report. Shown is a 20 percent allocation of the overall NASA budget for the past two fiscal years together with the next three fiscal years if the overall NASA budget grows in real terms by 10 percent per year. This can be compared to the budget actually provided in the past and requested in the future for NASA's science program exclusive of the Earth Observing System (EOS) (which is generally considered to be a "special initiative" and not included in a balanced science program). The additional funding for the Earth Observing System is also shown.

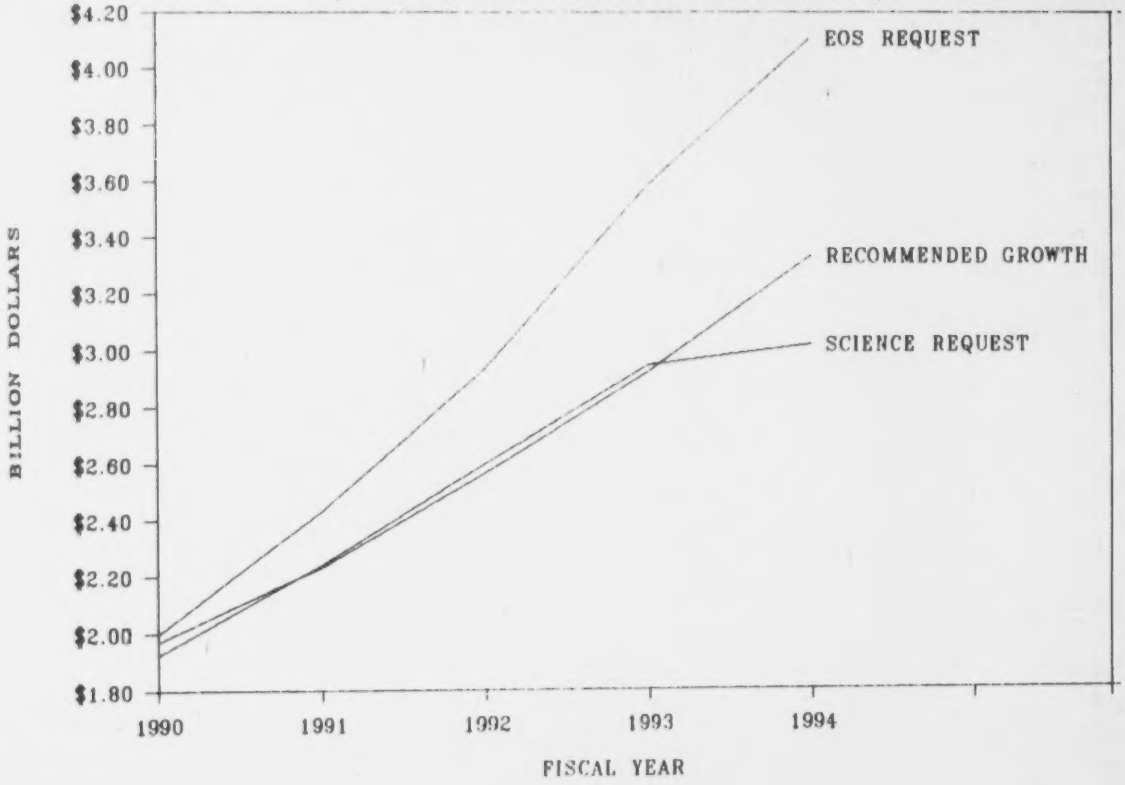
[figure 2]

As shown, if the budget continues to grow at the optimistic rate recommended by the Augustine report, NASA's fiscal year 1993 budget for the balanced science program contains virtually no margin and no planned possibility for a new start. Not until fiscal year 1994 does any margin materialize. The Committee is concerned that any failure of the NASA budget to grow at the optimistic rate will result in program stretch outs (with their attendant cost overruns), program cancellations, a malaise in new activity, and a general disruption in the science community. Science opportunities that have been promised cannot be provided.

In addition, the funding required for the special initiative, EOS, must be provided from elsewhere in the budget. NASA's multiyear budget request shows that funding for Research and Program Management and Space Flight is expected to stabilize and conceivably provide this funding wedge. Indeed, the Augustine report recommends substantial initiatives to reduce personnel overhead, Center overlap, and greater efficiencies in the Shuttle program. The Committee notes, however, that stabilizing these programs will be a challenging management task and genuine cost savings must be realized if such special initiatives

FIGURE 2. SCIENCE BUDGET PROJECTIONS

(COMPARED TO AUGUSTINE RECOMMENDATIONS)



as EOS are to be carried out above and beyond the balanced science program.

The Committee recommends that NASA reevaluate its strategic science plan to establish a more realistic budgetary context. Announcements of opportunity must be carefully managed and offered only if genuine and realistic opportunities exist. Finally, NASA should plan such special initiatives as EOS only if legitimate funding wedges can be developed from efficiencies elsewhere in the NASA budget.

Section 3(3) states that any major new launch system should be based on actual program requirements or policies established by Congress. The Committee's hearings have not identified any specific programmatic need for the proposed New Launch System at this time except for assembly of the Space Station. Although the Committee concurs with and endorses the recommendations of the Augustine report related to the need for a new launch system, the Committee seeks to integrate this recommendation into NASA's overall program plan.

Section 3(4) states that in fulfilling the mission of NASA as articulated in the original Space Act, the Administrator should undertake a program of research and development to enhance the competitiveness and cost effectiveness of the commercial industry. The Committee has provided funding for a component technology program for this purpose.

Section 3(5) states that a major activity of NASA should be to conduct research on pressing environmental problems such as global warming, ozone depletion, acid rain, deforestation, and smog.

SECTION 4: AUTHORIZATION OF APPROPRIATIONS

SECTION 4(a)(1)(A) SPACE STATION FREEDOM

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$2,028,900,000
1993	$2,426,000,000
1994	$2,790,800,000

Committee Recommendation:

Fiscal Year:	
1992	$
1993	$
1994	$

Committee authorization recommendation

Authorization is being withheld pending resolution of the program restructuring content and NASA's internal review of the Space Station management structure.

Program description

The Space Station program is directed toward the development of a permanently manned, 30-year research facility in low-Earth orbit. It is an International Space Station, being developed jointly by the United States, Canada, the European Space Agency, and Japan. The multi-Center program is managed by means of a Level II Space Station Program Office located in Reston, Virginia.

The Space Station program is in the process of being restructured to conform to Congressionally directed budgetary guidelines. In addition, the Space Station program management structure is being reviewed by senior NASA management.

Committee views

Space Station Program Restructuring

The Committee has been a strong and consistent supporter of the Space Station program. The Committee notes with some disappointment that over the last several years many of the original capabilities that NASA indicated would be provided for the Space Station have been deleted or deferred into the indefinite future as a result of budgetary, cost, and technical difficulties. However, the Committee believes that the original program objective of providing a robust permanent outpost in space and a

utilitarian laboratory for scientific activities should remain the preeminent goal.

The Advisory Committee on the Future of the U.S. Space Program and a number of other advisory groups have stated that the primary need for the Space Station is to do life sciences experimentation and to support the development and verification of long duration space operating systems for human space flight. A permanently manned, rather than a man-tended Space Station, is required to carry out those activities. The Committee is concerned, however, that the current restructuring of the Space Station program seriously weakens the commitment to achieving a permanently manned capability.

The tentative date for achieving a permanently manned capability (PMC) has been slipped three years into the future relative to the schedule in place just 18 months ago. In addition, the levels of budgetary reserves contained in the restructured program, the apparent lack of a specific funding plan for an Assured Crew Return Vehicle (ACRV), and a continuing uncertainty over the likely costs that will be associated with the operation of the Space Station mean that there may not be sufficient resources allocated in the program to achieve PMC.

The low level of reserves to cover problems during the crucial development period FY 1991-95 means there is an uncomfortably high likelihood of further schedule slippage during that time. Such schedule slips would have a significant cost impact, given that the program will be expending funds at the rate of $200 million per month during that period.

The ACRV is critical to the achievement of a permanently manned capability, and the Committee supports its development. However, the ACRV is estimated to cost $1-2 billion to develop, and NASA had not incorporated it into the Space Station budgetary plan during the restructuring.

The Committee reiterates its long-standing concern over the potential operations costs of the Space Station. The NASA Authorization Act for FY 1988 requires that the annual budget submission after FY 1997 for the basic operation and enhancement of the Station and its associated ground systems not exceed 10 percent of the total NASA budget. Control of operations costs must be a high priority of the Space Station program. Holding operations costs down may require changes in NASA's traditional approaches to operations. Indeed, in the Committee Report accompanying the FY 1987 NASA Authorization Act, the Committee urged NASA

> to consider innovative approaches to operations cost control including institutional measures which will decrease the number of ground personnel required to operate the Station, minimize the sustaining engineering manpower, and reduce the administrative overhead, all while maintaining an adequate margin of safety.

Since the Space Station is envisioned to be a national (and international)

research facility, NASA may wish to consider how other national research facilities are operated, such as the DOE laboratories, which are operated by private contractors. The Committee offers no specific recommendations to NASA at this time, but does emphasize that it will be paying close attention to NASA's approach to operations over the coming year.

The Committee continues to be concerned that the restructured Space Station design has not reduced transportation requirements for the assembly and outfitting of the Station. The number of Shuttle flights required to assemble and outfit the restructured Station to the point of PMC is approximately equal to the number required to assemble and outfit the previously baselined complete Phase 1 Station, even though the restructuring eliminated a set of solar arrays, two nodes, and other content that had been in the Phase 1 program.

The Committee again notes that many of the previously planned uses of the Space Station have been eliminated or deferred in recent years, and the Committee thus is troubled by the impact of the restructuring on the Space Station's remaining capabilities to support scientific research. The Committee urges NASA to address constructively the issues raised in the reports of the National Research Council and the NASA Advisory Council on the utilization of the Space Station for scientific experimentation.

The Committee notes with approval that the adoption of a pre-integrated truss should reduce assembly EVA and simplify the assembly task. In addition, the adoption of down-sized modules should, if they are designed and managed properly, allow greater ground-based outfitting and checkout of the modules prior to launch. The Committee commends the NASA and contractor personnel involved in the restructuring for their hard work and dedication to the task.

Program Management

Many internal and external advisory groups strongly recommended the establishment and support of an independent Space Station Level II program office. In fact, this Committee, in its 1986 report on its investigation of the Challenger accident, recommended that NASA should give special attention to moving the Shuttle program manager to NASA Headquarters

> to avoid the confusion and inter-center rivalry that result from having a large multi-center program managed out of one of the participating centers.

All of these recommendations led to the establishment of the current Level II Space Station office. Furthermore, the National Research Council's 1987 report to the White House on the Space Station program recommended that

> NASA management must emphasize that the Space Station Program Director [i.e., the head of the Level II office] is the principal line manager of the Space Station Program and is accountable for the successful development of the Space Station. He must be equipped with authority

commensurate with this accountability.

and

> The Space Station Program Office [i.e., Level II] must be continually supported and reinforced by senior NASA management. There are likely to be tendencies for control of the Space Station Program to move away from the Program Office to the NASA Centers. Such diffusion of influence would be highly inappropriate for the Space Station Program.

On the other hand, the Augustine Committee report clearly recommended a revision of this approach and the focusing of program management closer to the participating NASA Centers. In addition, many have argued that the existence of an independent Washington based program office is duplicative and costly. The Committee is aware of the substantial difficulties NASA has had in attracting highly qualified personnel for the Level II office.

Furthermore, the Committee fully recognizes that different management structures may be required for each major phase of the Station program. This need must, however, be balanced against the potential costs and loss of control that may accompany disruptive management changes. The need to avoid disruptions would appear to be particularly important over at least the next year, given that, as a result of the restructuring, "delta PDRs" and a Man-Tended Phase Review will have to be conducted, Work Package responsibilities will have to adjusted, program documentation will have to be revised, and so forth. Indeed, this type of activity may well persist until the Critical Design Review.

Since previous management plans submitted to the Congress have not discussed a change in the management structure like that which appears to be contemplated, the Committee requests that NASA develop a comprehensive long range management plan for the Station including the evolution of systems engineering and integration and operations responsibilities. This plan should recommend clear program responsibilities for the remaining phases of the Station program. In addition, the report must identify the cost and schedule impacts of proposed changes to the current management approach. The Committee requests that this plan be submitted accompanying any proposed management change but not later than December 31, 1991.

SECTION 4(a)(1)(B) SPACE TRANSPORTATION CAPABILITY DEVELOPMENT

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year	
1992	$879,800,000
1993	$999,800,000
1994	$997,400,000

Committee Recommendation:

Fiscal Year:	
1992	$629,800,000

1993.....$724,800,000
1994.....$722,400,000

Committee authorization recommendation

Section 4(a)(1)(B) authorizes the appropriation of $629,800,000 in fiscal year 1992 for Space Transportation Capability Development activities. This represents a decrease of $75,000,000 below the President's request. This decrease reflects the combined effect of: a $20,000,000 decrease in funding for Upper Stages, deferring funding for the purchase of a Centaur upper stage pending completion of negotiations with the Defense Department; a $10,000,000 decrease in funding for Spacelab activities, deferring some hardware replacements; a $15,000,000 decrease in the Engineering and Technical Base, reflecting a slower than planned rate of growth; a decrease of $15,000,000 in Payload Operations and Support Equipment, deferring some Space Station support; and a $15,000,000 decrease in Advanced Programs, deferring increased emphasis on a personnel transportation system.

Section 4(a)(1)(B) also authorizes the appropriation of $724,800,000 in fiscal year 1993 and $722,400,000 in fiscal year 1994 for Space Transportation Capability Development activities. Excluding the New Launch System, these ammounts are equal to the Administration's estimate.

Program description

The principal areas of activity in Space Transportation Capability Development include the operation of Spacelab flight hardware with some continuing development activities; procurement of Upper Stages required to place satellites in high altitude orbits; the Engineering and Technical Base support at the manned space flight centers; Payload Operations and Support Equipment for accommodating NASA payloads that will fly on the Space Shuttle; Advanced Programs study and evaluation efforts; Advanced Transportation Technology efforts including the Administration's request for the definition and preliminary development of a new launch vehicle capability and improved propulsion technology; and the design and development of the United States/Italian Tethered Satellite System.

SECTION 4(a)(1)(C) PHYSICS AND ASTRONOMY

President's request for fiscal year 1992 and estimates for subsequent years:
  Fiscal Year:
    1992.....$1,140,600,000
    1993.....$1,321,400,000
    1994.....$1,308,500,000
Committee Recommendation:
  Fiscal Year:
    1992.....$1,096,600,000

1993.....$1,241,400,000
1994.....$1,248,500,000

Committee authorization recommendation

Section 4(a)(1)(C) authorizes $1,096,600,000 in fiscal year 1992, $1,241,400,000 in fiscal year 1993, and $1,248,500,000 in the fiscal year 1994 for Physics and Astronomy. Of this amount, $6,000,000 has been transferred from the Materials Processing in Space budget line to allow alternate development of experiments that were to be Space Station attached payloads. The reductions from the President's request shall be taken from the Advanced X-Ray Astrophysics Facility account.

Program description

The objectives of the Physics and Astronomy program are to increase understanding of the origin and evolution of the universe, the fundamental laws of physics, and the formation of stars and planets. The objectives of the Physics and Astronomy program are accomplished by means of a mixture of large free-flying space missions, Explorer spacecraft, Shuttle/Spacelab flights, and suborbital missions.

The Physics and Astronomy program will continue development of the third of the Great Observatories, the Advanced X-Ray Astrophysics Facility (AXAF) in fiscal year 1992.

Work will also continue on the Global Geospace Science (GGS) mission. This mission supports an international cooperative activity, the Collaborative Solar Terrestrial Research (COSTR) project. Teams from the United States, the European Space Agency, and Japan are involved in COSTR.

The Explorer program will continue development activities on the X-ray Timing Explorer (XTE) in FY 1992. In addition, two new Explorers, the Advanced Composition Explorer (ACE) and the Far Ultraviolet Spectroscopic Explorer (FUSE), will begin development in fiscal year 1992.

Committee views

Advanced X-Ray Astrophysics Facility (AXAF)

The Committee is concerned that the Advanced X-Ray Astrophysics Facility (AXAF) program has been encountering technical difficulties in the mirror metrology activities associated with the development of the mirrors for the observatory. At the same time, the Committee recognizes that the development of the mirrors is technically very challenging. NASA indicates that the difficulties are being resolved, and the Committee hopes that this will prove to be the case. However, earlier spacecraft programs have demonstrated the programmatic risks in attempting to move too rapidly in the face of technical problems. For that reason, and because the overall budget request for space science is not sustainable, the Committee reluctantly is slowing the rate of increase of AXAF funding.

Deletion of Space Station Attached Payloads

The Committee regrets that the attached physics and astronomy payloads have been deleted from the Space Station program as a part of the restructuring. The experiments that were to have been carried out by means of the attached payloads have been a part of the Office of Space Science and Applications Strategic Plan for a number of years. Indeed, investigator teams, including a number from universities, had already been formed to implement those peer-reviewed proposals that had been approved by NASA. If the Strategic Plan's approach to setting priorities in the space science program is to have meaning, then provision should be made to provide alternative access to space for those experiments that have been part of the Strategic Plan but which have lost their originally planned payload carrier. Thus, the Committee is transferring $6,000,000 from the Space Station utilization account of the Materials Processing in Space budget line to fund development of alternative means of conducting experiments that were to fly as attached payloads on the Space Station.

Astronomy and Astrophysics in the 1990s

The Committee notes with interest that the National Academy of Sciences (NAS) has completed a review of potential space-based and ground-based astronomical and astrophysical projects that could be undertaken in the 1990s. The NAS committee achieved a consensus on a number of recommendations to strengthen the field, both through a judicious selection of missions and through improvements to infrastructure. The Committee urges NASA to give serious consideration to the findings and recommendations of the NAS study when the Office of Space Science and Applications revises its Strategic Plan.

An important feature of the astronomy and astrophysics program of the 1990s is the provision of small payload opportunities, which NASA plans to provide through the Small Explorer (SMEX) program. The SMEX program is intended to offer low cost, flexible, and rapid access to space for small and innovative payloads. The Committee thus reacts with some concern to reports from the science community that the SMEX program as currently structured may not achieve those goals. Specifically, it is important that the paperwork and procedures associated with the SMEX program be streamlined to the maximum extent possible. In addition, flexibility should be available to experimenters in the design of missions, and rigid standardization should not be forced on disparate missions. The Committee urges NASA to work with the science community to ensure that the SMEX program is responsive to the needs of the investigators.

SECTION 4(a)(1)(D) LIFE SCIENCES

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:

1992.....$183,900,000

1993.....$284,000,000
1994.....$326,100,000
Committee Recommendation:
Fiscal Year:
1992.....$183,900,000
1993.....$224,000,000
1994.....$246,100,000

Committee authorization recommendation

Section 4(a)(1)(D) authorizes $183,900,000 in fiscal year 1992, $224,000,000 in fiscal year 1993, and $246,100,000 in fiscal year 1994 for Life Sciences. Of the amount authorized in fiscal year 1992, $2,000,000 is provided for cooperative life sciences research activities on the Soviet space station Mir.

Program description

The Life Sciences program is directed toward increased understanding of human responses and adaptability to the space environment. Such knowledge is essential to the success of the ambitious human activities contemplated under the Space Exploration Initiative. It also has the potential to contribute to our understanding of terrestrial diseases and medical problems. The Life Sciences program will also provide information important to the success of Space Shuttle and Space Station operations.

Several Shuttle Spacelab missions with significant levels of life science experimentation are planned for fiscal year 1992. Definition and development of an integrated Centrifuge facility for use on Space Station will continue in fiscal year 1992. Lifesat, a reusable reentry satellite for life sciences research, will be a new program initiative in fiscal year 1992. Its mission initially will focus on radiation research.

Committee views

Lifesat

The Committee has strongly supported the need for the capabilities afforded by Lifesat. In addition to fulfilling the focussed research needs in space radiation, the Committee intends that the Lifesat program will provide to the life sciences community a means for frequent, low cost flight opportunities. NASA will have to exercise strong program discipline to ensure that Lifesat's development and recurring costs are kept under control. The Committee stated in H.R. 5649, the National Aeronautics and Space Administration Multiyear Authorization Act of 1990, H. Rept. 101-763, that it intended to review NASA's performance in meeting this goal. The significant increase in Lifesat program cost estimates over the last year concerns the Committee. Therefore, the Committee is reducing its authorization for the Lifesat program in fiscal year 1993 and fiscal year 1994 below NASA's planned runout. The Committee reiterates that continued Lifesat program cost growth will not be supported, since uncontrolled cost

growth in any one life sciences flight project can jeopardize the conduct of a balanced Life Sciences program.

Cooperative Research on Mir

NASA has cooperated with the Soviet life sciences research community for a number of years. The Committee supports the continuation of appropriate cooperative activities in the life sciences. To that end, the Committee is providing $2,000,000 of the fiscal year 1992 Life Sciences authorization for cooperative life sciences research activities on the Soviet space station Mir. The Committee directs NASA, in consultation with its Advisory Committee to provide a comprehensive plan for cooperative research activities on Mir by December 1, 1991.

SECTION 4(a)(1)(E) PLANETARY EXPLORATION

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$627,300,000
1993	$635,300,000
1994	$643,500,000
Committee Recommendation:	
Fiscal Year:	
1992	$299,300,000
1993	$251,900,000
1994	$263,400,000

Committee authorization recommendation

Section 4(a)(1)(E) authorizes $299,300,000 in fiscal year 1992, $251,900,000 in fiscal year 1993, and $263,400,000 in fiscal year 1994 for Planetary Exploration. The amounts authorized in Section 4(a)(1)(E) exclude funding for the Comet Rendezvous Asteroid Flyby/Cassini (CRAF/Cassini) mission. A multiyear authorization for the CRAF/Cassini mission, not to exceed $1,600,000,000, was provided in Public Law 101-611 (Nov. 16, 1990).

Program description

The Planetary Exploration program focuses on the scientific exploration of the solar system, including the planets, their satellites, comets, asteroids, and the interplanetary medium.

In fiscal year 1992, the Mars Observer spacecraft will be launched on an expendable launch vehicle to Mars, where it will go into orbit about the planet. Its mission objectives are to map the global surface composition, atmospheric structure and circulation, topography, gravity, and magnetic fields of Mars.

Development activities will continue on the CRAF/Cassini mission. The CRAF/Cassini program was restructured in early 1991. CRAF's mission is to pass by an asteroid and rendezvous with a comet, making long-term measurements. Cassini is intended to undertake long-term observations of Saturn's atmosphere, rings, magnetic field, and moons. As part of the mission, a probe will be launched into the atmosphere of the moon Titan.

Committee views

Comet Rendezvous Asteroid Flyby (CRAF) Program

The Committee is troubled by the turbulence in the CRAF program over the past year. The Committee recognizes that the withdrawal of planned foreign participation from part of the spacecraft development effort had an adverse impact on the program plan. Nonetheless, it appears to the Committee that there was an underestimation of the technical risk associated with the program, especially with respect to the Penetrator, which has led to significant upward cost pressures. The subsequent elimination of the Penetrator has led to a marked decrease in the science content of the mission relative to the original plans. That such a dramatic descoping had to occur so soon after the completion of the Phase B activities that should have bounded the technical and cost risks of the program prior to the initiation of Phase C/D is disturbing. The Committee will be watching the progress of this program very carefully over the coming year.

Planetary Exploration and the Proposed Office of Exploration

The Advisory Committee on the Future of the U.S. Space Program suggested that NASA consider establishing an Associate Administrator for Exploration "with responsibility for both robotic and manned exploration of the Moon and Mars." The NASA Administrator has indicated that he will establish a new Office of Exploration. To date, no decision has been announced regarding the potential transfer of robotic mission responsibility from the Office of Space Sciences and Applications (OSSA) to the new Office of Exploration.

The Committee has reservations about the wisdom of such a transfer. Robotic exploration of the Moon and Mars has long been an integral part of a balanced planetary science program and would likely remain so even in the absence of a human exploration program. There do not appear to be compelling reasons to eliminate OSSA's responsibility for such robotic missions, although there clearly should be close coordination with the Office of Exploration. The Committee would therefore encourage the NASA Administrator to formally solicit the views of the scientific community through the appropriate solar system exploration committees of the NASA Advisory Council and the National Academy of Sciences prior to any decision on where to assign the responsibility for lunar and Mars robotic missions.

SECTION 4(a)(1)(F) EARTH SCIENCE AND APPLICATIONS

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$775,600,000
1993	$1,108,000,000
1994	$1,562,500,000

Committee Recommendation:

Fiscal Year:	
1992	$725,600,000
1993	$830,000,000
1994	$950,500,000

Committee authorization recommendation

Section 4(a)(1)(F) authorizes the appropriation of $725,600,000 in fiscal year 1992 for Earth Science and Applications. This represents a reduction of $50,000,000 from the President's request, reflecting the combined effect of: a reduction of $75,000,000 in the Earth Observing System, including the EOS Data and Information System; the addition of $15,000,000 for Earth Probes; the addition of $4,000,000 for Mission Operations and Data Analysis to continue those data analysis activities deferred in fiscal year 1991 by the reprogramming of $4,000,000 for the Ocean Color Mission data purchase; the addition of $1,000,000 to for converting data collected by classified remote sensing systems to civilian uses; and the addition of $5,000,000 only for the purchase of Landsat data for global change research. The Committee intends that NASA and the private operator of Landsat reach a mutual agreement on an equitable and low-cost price for Landsat Thematic Mapper data. Section 4(a)(1)(F) also authorizes the appropriation of $830,000,000 in fiscal year 1993 and $950,500,000 in fiscal year 1994, which represents ten percent real growth in the Earth Science and Applications budget.

Program description

The Earth Sciences program consists of the Earth Observing System (EOS), the Earth Probes, precursor missions, and Earth science. These programs constitute NASA's Mission to Planet Earth, which is the space-based data collection and analysis activity of the U.S. Global Change Research Program. NASA's programs are part of a larger international effort related to gaining a better understanding of the Earth's environment and global change phenomena.

The Earth Observing System will be a long-term effort to obtain a fifteen-year data set on atmospheric, oceanic, and geological processes and interactions, with the objective of examining critical global change phenomena and studying the Earth as a complete system. The program envisions a series of EOS-A and EOS-B spacecraft in polar orbit, each with a suite of instruments to allow simultaneous measurement of rapidly changing phenomena and intercorrection of instrument measurements. The first large platform (EOS-A) is scheduled for launch in fiscal year 1999. The Administration is currently conducting an external engineering review

of the EOS program.

A key element of the EOS program is the Earth Observing System Data and Information System (EOSDIS). One of its major functions is handling the distribution, storage, and archiving of the data obtained from the EOS spacecraft. EOSDIS will also incorporate data from instruments on other U.S. and foreign Earth observation spacecraft. An indispensable complement to the EOSDIS effort is support for scientific research and data analysis activities.

Another extremely important part of the Mission to Planet Earth is the Earth Probes program. Earth Probes instruments will be flown on small and medium-sized satellites to obtain high-priority data in the near term or data which cannot be obtained by the EOS spacecraft. Precursor missions, including TOPEX/Poseidon and the Upper Atmospheric Research Satellite, will be flown in the next several years to improve our understanding of terrestrial, atmospheric, and oceanic processes. Finally, data from operational satellites, including Landsat and the environmental satellites operated by the National Oceanic and Atmospheric Administration, are essential to the Global Change Research Program.

Committee views

Earth Observing System

The Committee strongly supports the Mission to Planet Earth program because of its potential to dramatically improve our understanding of the Earth's environment and global change phenomena, including the impact of human activities on the environment. The Committee remains very concerned that the Earth Observing System program is not sufficiently resilient with respect to future budget shortfalls. Future budget constraints may lead to smaller funding levels than required to keep the original program on schedule, especially in a program with such large future funding requirements. Already, a shortfall in the expected fiscal year 1992 budget request has forced deletion of one major instrument from the first EOS satellite, a delay in the launch of the first EOS satellite, and a delay in developing instruments for follow-on satellites. Cost overruns and technical difficulties in a program of this complexity may also cause delays and reductions in capability.

Much of the EOS program's lack of resilience can be attributed to the placement of all of the proposed instruments for EOS-A on one large platform. Not only does this lead to greater technical complexity, but all instruments and spacecraft systems must be developed in parallel leading to highly interactive schedule and cost risks.

The Advisory Committee on the Future of the U.S. Space Program found that "a combination of different size spacecraft appears to be most appropriate to meet the needs of simultaneity, accuracy, continuity, and robustness." The Committee notes that while the large platform concept addresses scientific requirements for simultaneity, these requirements are

not absolute and other objectives, including continuity, program resilience and early return of data, are equally important.

As a result of the Augustine Committee's recommendation, the Administration is conducting an external engineering review of the EOS program. The results of this review will be essential for determining the future structure of the Mission to Planet Earth program. The Committee encourages this review panel to carefully examine the structure and content of the entire EOS program, including the first EOS-A satellite, and take concrete steps to make the program more resilient. The Committee recommends that the review panel consider the advantages and disadvantages of flying the EOS-A group of instruments on three or more smaller satellites. The Committee believes that while such a configuration may not be technically optimal, it would constitute a more resilient approach. If future budgets fall short of expectations, parts of the program can proceed on schedule while less urgent parts are deferred. The Committee also urges the review panel to consider the role of Landsat in the Mission to Planet Earth effort.

In the absence of the report of this external engineering review panel and an affordable plan for the EOS program, the Committee is not confident that the proposed program can be successfully funded and implemented. The Committee has reduced the Earth Observing System program by $75,000,000 in fiscal year 1992, which represents approximately half of the requested increase. The Committee expects that this can be accomplished by reducing the reserves for the EOS instruments and deferring some activities, reducing or eliminating funds for EOS-B and EOS-A follow-on studies, and reducing the level of support for internal EOSDIS activities while maintaining the current schedule for the EOSDIS procurement and continuing to rapidly develop the EOSDIS Version 0. Alternatively, if the external engineering review so recommends, NASA could implement an option to fly the EOS-A instruments, or variants, on more than one smaller spacecraft.

The Committee has provided for ten percent real growth in the total budget for Earth Science and Applications in fiscal years 1993 and 1994, which reflects the Augustine Committee recommendation for ten percent real growth for NASA. The Committee would consider increasing the allocations for fiscal years 1993 and 1994 pending the submittal of the report of the external engineering review, as well as NASA's response, and the identification of an adequate budget "wedge" for the Earth Observing System.

The Committee notes the current lack of a U.S. launch vehicle capability with a payload capacity to polar orbits intermediate between that of the Atlas E and Titan IV launch vehicles. Establishing such a capability requires modifications and additions to the current facilities at Vandenberg Air Force Base and modifications to existing launch vehicles. The Committee recommends that NASA work with the Department of Defense (DOD) to ensure that any facilities planned by the DOD will also be available for use by NASA and any launch vehicle modifications take into account NASA's potential needs. The Committee also believes that NASA

should not be restricted from using foreign launch vehicles when a similar capability is not available in the United States if such policies prevent the establishment of a resilient and cost-effective scientific program.

EOS Data and Information System

The Committee recognizes that NASA has devoted considerable attention and resources to the EOS Data and Information System (EOSDIS). The Committee views the EOSDIS as the most challenging aspect of the Mission to Planet Earth program and the key to obtaining the maximum benefits from our investment in this program. The Committee recommends that NASA maintain the schedule for the EOSDIS procurement and continue rapid development of the EOSDIS Version 0.

The Committee further recommends that NASA plan to incorporate data from other U.S. and foreign environmental satellites, both current and planned, in the operational version of EOSDIS. Use of existing data sets from other environmental satellites in prototype versions of the EOSDIS does not satisfy year the need to integrate data sets from all available sources and make them accessible on a long-term basis. The Committee believes that NASA needs to work more closely with the international community to assure compatibility between the EOSDIS and data obtained from foreign Earth observation spacecraft, and reduce unnecessary duplication between U.S. and foreign programs.

Landsat Data Purchase

The Committee notes the consensus of the scientific community, as reflected in a report last year by the National Academy of Sciences, that Landsat data are sufficiently important to global change research that they should be incorporated in the EOSDIS. The Landsat data archives constitutes a two-decade record of environmental changes. Furthermore, while data from the EOS will not be available until 1999 or later, Landsat data are available now. Even after EOS-A is launched, Landsat data will constitute a valuable complement to the data from the EOS instruments.

The Committee has made $5,000,000 available only for the purchase of Landsat data for the Global Change Research Program. The Committee intends that NASA and the private operator should reach a mutual agreement on an equitable and low-cost price for Landsat data for the Global Change Research Program.

The Committee believes that NASA and the private operator of Landsat should take full advantage of the flexibility provided by the Land Remote-Sensing Commercialization Act of 1984, Public Law 98-365, as amended, which allows the private operator of the Landsat system to provide data at reduced prices for any research and development programs if a complete disclosure of the results of the research and development is made publicly available and the data are not used for commercial purposes or in substantial competition with data available directly from the Landsat operator. The Committee notes that two-year old Landsat Multi-Sprectral

Scanner data are now available at 25 percent of the nominal price, reflecting the approximate marginal cost of reproduction and distribution. The Committee expects that arrangements could be made to provide new and archived Thematic Mapper data in a like manner.

The Committee does not view this data purchase program as a long-term solution to the problem of Landsat data continuity. The Committee urges NASA to coordinate with the other agencies involved in the U.S. Global Change Research Program to make more permanent arrangements which assure the availability of Landsat data to the civilian community. The Committee recognizes that this is not an issue for NASA alone, but as the agency responsible for collecting environmental observations from space for the Global Change Research Program, NASA should take the lead within the Committee on Earth and Environmental Sciences and the National Space Council to ensure that Landsat data will be available to the global change research community. The Committee believes that taking advantage of existing capabilities such as Landsat will enhance the cost-effectiveness of the Mission to Planet Earth program and provide important data sooner. The Committee believes that the fact that Landsat has commercial as well as scientific capabilities should not deter this country from continuing a program whose dividends have been so great.

The Committee also notes with great concern the possibility that a significant fraction of Landsat imagery acquired since 1972 will be lost in coming years as storage media degrade or the original processing systems become inoperable. The Committee believes that the Landsat data archive represents the fruits of a $1.5 billion public investment in Landsat and contains incredibly valuable information on the environment. The Committee recognizes that NASA is not the agency responsible for the data archives, but urges NASA to work with other responsible agencies to ensure that this data archive is transferred to more permanent storage media and incorporated to the extent practicable into the EOS Data and Information System (EOSDIS). The Committee believes that the Land Remote Sensing Commercialization Act, as amended, provides a sufficient mechanism for providing archived Landsat data to the EOSDIS.

Earth Probes

The Committee strongly supports an aggressive Earth Probes program. The Earth Probes program, consisting of both small and medium-size spacecraft, will allow important global change phenomena to be observed and studied in the near term, including investigations which cannot be carried out by the Earth Observing System. The Committee believes that the Earth Probes program is as important to our understanding of global change phenomena as EOS. Budgetary problems which might occur in the EOS program should not be allowed to adversely impact the content or schedule of the Earth Probes program.

In order to conduct the Mission to Planet Earth as a continually evolving program, as recommended by the Augustine committee, the Committee urges NASA to maintain sufficient flexibility in its program and budget

planning to respond quickly to new needs as they arise. The Committee believes that the Earth Probes program can serve to shorten the time between the generation of new scientific and environmental monitoring objectives and the return of relevant data from space.

The Committee notes with concern that the requested funding for Tropical Rainfall Measurement Mission (TRMM) is lower in fiscal year 1992 than the funding provided in fiscal year 1991 and regrets the deletion of the Earth science attached payloads from the space station. Accordingly, the Committee has added $15,000,000 for Earth Probes to accelerate development of TRMM and to make alternative arrangements to fly the attached payloads deleted from the space station program.

SECTION 4(a)(1)(G) MATERIALS PROCESSING IN SPACE

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year 1992	$125,800,000
Fiscal Year 1993	$201,400,000
Fiscal Year 1994	$233,600,000

Committee Recommendation:

Fiscal Year:	
1992	$115,800,000
1993	$201,400,000
1994	$233,600,000

Committee authorization recommendation

Section 4(a)(1)(G) authorizes the appropriation of $115,800,000 in fiscal year 1992 for Materials Processing in Space. The Committee intends that the reduction of $10,000,000 from the President's request in fiscal year 1992 be applied to the Space Station Utilization budget line. The Committee adopted language which transfers $6,000,000 from the Space Station Utilization budget line in Materials Processing in Space to the Physics and Astronomy budget line for alternative flight provisions for the physics and astronomy attached payloads deleted from the space station. The remaining reduction of $4,000,000 in fiscal year 1992 reflects the effects of the restructured Space Station program and the need to transition the utilization activities to life science after Permanent Manned Capability. In such case, materials science facilities and equipment scheduled to be available only after the PMC milestone will need to be reassessed. Section 4(a)(1)(G) also provides $201,400,000 in fiscal year 1993 and $233,600,000 in fiscal year 1994, in accordance with the President's request.

Program description

The Materials Processing in Space program uses the microgravity environment to conduct research in fundamental science, materials science, and biotechnology. The program includes ground-based research, Spacelab

45-073 O—91——26

and space shuttle payload development and operations, and space station utilization planning and payload development.

Committee views

Reduction in Funding for Space Station Utilization

The Committee believes that NASA should make other arrangements to fly the attached payloads deleted from the space station, which were supported in previous years by the Space Station Utilization budget line. Accordingly, the Committee has transferred $6,000,000 from the Space Station Utilization line in Materials Processing in Space to the Physics and Astronomy line. In addition, the Committee has made an additional general reduction to the Space Station Utilization line, reflecting the Committee's concern that the programs to develop large materials processing facilities for the space station are not under control and that materials processing facilities scheduled to be available after Permanent Manned Capability should be reassessed.

SECTION 4(a)(1)(H) COMMUNICATIONS

President's request for fiscal year 1992 budget and estimates for subsequent years:

Fiscal Year 1992	$39,400,000
Fiscal Year 1993	$34,700,000
Fiscal Year 1994	$31,000,000

Committee Recommendation:

Fiscal Year:	
1992	$39,400,000
1993	$34,700,000
1994	$31,100,000

Committee authorization recommendation

Section 4(a)(1)(H) authorizes the appropriation of $39,400,000 in fiscal year 1992, $34,700,000 in fiscal year 1993, and $31,100,000 in fiscal year 1994 for Communications, in accordance with the President's request.

Program description

The main activity in communications is the Advanced Communications Technology Satellite (ACTS) program, including development of terminals for use in the ACTS experiments program. The ACTS launch is scheduled for fiscal year 1993. Other components of the communications program include research and hardware development for advanced communications concepts, research and development for the search and rescue program, and radio science studies.

Committee Views

ACTS Experiments Program

The Committee strongly supports the transfer of the ACTS experiments program to the Office of Commercial Programs, which the Committee believes will place a greater emphasis on industry involvement. However, the Committee is concerned that the funding intended for an industry experiments program using ACTS may be excessively diluted by institutional expenditures and non-ACTS research activities of new Centers for the Commercial Development of Space (CCDS) if additional funds are not made available. The Committee believes that funding intended for an industry experiments program using ACTS should be sustained at a level that will guarantee direct ACTS utilization by industry and that this should be over and above resources directed at the establishment of the CCDSs.

SECTION 4(a)(1)(I) INFORMATION SYSTEMS

President's request for fiscal year 1992:
  Fiscal Year 1992.....$42,000,000
Committee Recommendation:
  Fiscal Year:
    1992.....$42,000,000

Committee authorization recommendation

Section 4(a)(1)(I) authorizes the appropriation of $42,000,000 in fiscal year 1992 for Information Systems. NASA plans to eliminate this budget line beginning in fiscal year 1993 and distribute its activities to other functions within the Office of Space Science and Applications.

Program description

The objective of the information systems program is to provide advanced data systems required to support flight projects in the Office of Space Science and Applications. In addition, in fiscal year 1992 NASA plans to initiate an effort to revitalize current space science data holdings.

Committee views

Funding for Preserving Existing Data and Handling New Data

Major science missions during the 1990s will lead to an explosion in data received. NASA's data archiving and distribution system will be severely stressed. Advances in information and data management systems are required if NASA is to support the need of the scientific community to access this data. In addition, NASA's previous efforts to preserve existing data archives have been found to be inadequate.

The Committee is concerned that the elimination of this budget line in future years will result in a reduced emphasis on preserving existing space science data and developing systems to cope with the torrents of new scientific data expected in the 1990's. The Committee urges NASA to provide the information systems program with the resources needed to preserve the existing data collected over the last 30 years and deal with

the anticipated influx of new space science data.

SECTION 4(a)(1)(J) TECHNOLOGY UTILIZATION

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$32,000,000
1993	$31,700,000
1994	$33,000,000

Committee Recommendation:

Fiscal Year:	
1992	$27,000,000
1993	$29,700,000
1994	$33,000,000

Committee authorization recommendation

Section 4(a)(1)(J) authorizes the appropriation of $27,000,000 in fiscal year 1992, $29,700,000 in fiscal year 1993, and $33,000,000 in fiscal year 1994 for Technology Utilization.

Program description

The objectives of NASA's technology utilization programs are (1) to accelerate the application of new technology by the private sector; (2) to encourage secondary uses of NASA technology in non-aerospace fields, in both the public and private sectors; and (3) to develop applications of NASA's aerospace technology to meet non-aerospace needs. A network of Industrial Applications Centers (IAC's) and technology utilization officers at NASA centers form the core of the agency's technology transfer efforts. An open competition is planned to replace the current network of IAC's with six new centers geographically distributed around the country.

Committee views

Reduction in Rate of Funding Increase

The Committee strongly supports efforts to make NASA's technology transfer program more effective but believes that this can be accomplished within a more modest budget envelope. The Committee does not believe that the requested growth of more than thirty percent in fiscal year 1992 can be accomodated, especially given the large overall budget growth requested by the Office of Commercial Programs. Accordingly, the Committee has applied a general reduction of $5,000,000 to Technology Utilization in fiscal year 1992. The Committee believes that all activities within this budget line should share in the general reduction.

SECTION 4(a)(1)(K) COMMERCIAL USE OF SPACE

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$118,000,000
1993	$144,200,000
1994	$137,400,000

Committee Recommendation:

Fiscal Year:	
1992	$95,000,000
1993	$132,200,000
1994	$130,400,000

Committee authorization recommendation

Section 4(a)(1)(K) authorizes the appropriation of $95,000,000 in fiscal year 1992, $132,200,000 in fiscal year 1993, and $130,400,000 in fiscal year 1994 for Commercial Use of Space activities. The reduction from the President's request is without prejudice and shall be accomodated by means of a general reduction. The Committee takes this action reluctantly, but the rapid increase in funding required for the major flight programs envisioned must be fit into the overall funding allocation that is likely to be available for NASA.

Program description

The Commercial Use of Space program primarily supports a network of sixteen Centers for the Commercial Development of Space (CCDS). The CCDSs are located at state and private universities and research institutes. The purpose of the CCDS program is to encourage increased private sector investment in research geared toward examining potential commercial uses of space.

The scientific and engineering researchers at the CCDSs are supported by basic grants of approximately $1 million per center. In addition, NASA funds payload development, payload integration, shuttle integration, and transportation into space for CCDS experiments. NASA's support to the CCDSs totals over $100 million in the fiscal year 1992 budget request, nearly double the fiscal year 1991 budget. The remainder of this account supports commercial development studies, headquarters support contracts, and NASA field center collaborative work with industry.

Committee views

Budgetary Growth Associated with Flight Programs

The Committee is encouraged by NASA's ambitious plans for its Centers for the Commercial Development of Space (CCDS). The Committee nevertheless believes that the large bulge in the budget of the Office of Commercial Programs (OCP) over the next three fiscal years cannot be achieved in the current constrained budget climate. The Commercial Use of Space budget request for fiscal year 1992 is nearly twice the fiscal year 1991 budget.

Most of this bulge is attributable to the simultaneous initiation of two space transportation projects, Spacehab and COMET, which are intended to provide flights for experiments developed by NASA's CCDSs. For this reason, the Committee has made a general reduction of $23,000,000 in fiscal year 1992. This authorization still provides a greater than 50 percent increase in funding in fiscal year 1992.

The Committee notes that the practice of "front loading" commercial service contracts in order to establish a basis for investor confidence presents Congress with an untenable situation. That is, such contracts must be funded or such companies will encounter severe financial disruption. In addition, Congress must provide an inordinate amount of funding initially compared to the services received. The Committee intends to review the possibility of providing NASA with termination liability authority to alleviate these problems.

Industrial Participation

The Committee is encouraged by the large number of industrial affiliates who have worked with or expressed interest in the research being done by the CCDSs. However, a smaller number of these firms have provided significant cash support to the CCDSs and industry cash support remains a small percentage of total cash and in-kind support to the CCDS program. The Committee believes that it is essential that all of the research performed at the CCDSs be driven by interest from industry and receive direct financial support from industry. The Committee believes that the best measure of industrial interest in a project is direct financial (cash) support. The accounting methods for estimating the dollar value of in-kind support such as personnel and equipment do not appear to be consistent across the CCDSs and may not accurately reflect the value industry would place on this support. If NASA plans to continue using in-kind contributions as a measure of industry support, it should develop uniform standards for determining the value to industry of such contributions.

The Committee recommends that NASA consider ways to provide each center with greater incentives for obtaining industry funding for projects they propose to undertake. A matching fund program, whereby NASA provides a lower level of basic grant funding than it currently provides but matches industry cash contributions on a one-for-one or two-for-one basis up to some limit, would be one option for accomplishing this objective. Another option would be to prioritize payloads for flight based not just on technical merit but also on the amount of cash support received from industry. Projects with greater levels of industry support and equal technical merit should fly before projects with lower levels of support. A third option would be to require new CCDSs to list in their proposals the financial support from industry they will obtain if they receive a specific level of NASA support. NASA could evaluate the proposals based on the level of industry support and the credibility of such estimates.

Furthermore, the Committee notes that three of the CCDSs have received extremely little or no cash from industry. NASA originally planned to

support the centers for only the first five years, after which time the centers would either become self-sustaining or would be discontinued. The Committee recommends that NASA consider periodically recompeting the contracts for CCDS status. New groups of researchers and industry partners might be better able to take advantage of NASA's support. Since NASA is planning to issue a request for proposals for one or two new centers to concentrate on satellite communications research, the Committee recommends that NASA consider recompeting the contracts for the three CCDSs that have not attracted industry funding and maintain the total number of CCDS at sixteen. Maintaining a fixed number of CCDSs at this time is consistent with the inability to provide all of the large budget growth requested by the Office of Commercial Programs.

The Committee requests that NASA provide it with a report, by November 1, 1991, outlining NASA's plans for increasing the incentives for centers to obtain industry cash support, describing NASA's review process for evaluating the level of industry support obtained by the centers, and describing NASA's plans for periodically recompeting the CCDS contracts. The Committee also strongly suggests that NASA require each CCDS to include in its annual report to NASA a detailed breakdown of cash and in-kind support received from industry.

SECTION 4(a)(1)(L) AERONAUTICAL RESEARCH AND TECHNOLOGY

President's request for fiscal year 1992 and estimates for subsequent years:
  Fiscal Year:
    1992.....$
    1993.....$
    1994.....$
Committee Recommendation:
  Fiscal Year:
    1992.....$
    1993.....$
    1994.....$

Committee authorization recommendation

  Section 4(a)(1)(L) authorizes

Program description

Committee views

SECTION 4(a)(1)(M) TRANSATMOSPHERIC RESEARCH AND TECHNOLOGY

President's request for fiscal year 1992 and estimates for subsequent years:
  Fiscal Year:
    1992.....$
    1993.....$
    1994.....$
Committee Recommendation:
  Fiscal Year:
    1992.....$
    1993.....$
    1994.....$

Committee authorization recommendation

  Section 4(a)(1)(M) authorizes

Program description

Committee views

SECTION 4(a)(1)(N) SPACE RESEARCH AND TECHNOLOGY

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$354,800,000
1993	$321,700,000
1994	$317,200,000

Committee Recommendation:

Fiscal Year:	
1992	$324,800,000
1993	$351,700,000
1994	$367,200,000

Committee authorization recommendation

Section 4(a)(1)(N) authorizes $324,800,000 in fiscal year 1992 for Space Research and Technology activities. This represents a decrease of $30,000,000 below the President's request. This decrease reflects the combined effect of: an increase of $10,000,000 in the Research and Technology Base to initiate a research and development program focused on developing propulsion, guidance & control, vehicle, ground support, and other technologies that could benefit the commercial launch vehicle industry within the United States; and a decrease of $40,000,000 in Space Automation and Telerobotics reflecting the deletion of the $55,000,000 Flight Telerobotic Servicer project, and the reallocation of $15,000,000 to other automation and telerobotic activities.

Section 4(a)(1)(N) also authorizes the appropriation of $351,700,000 in fiscal year 1993, and $367,200,000 in fiscal year 1994 for Space Research and Technology activities. The authorization for fiscal year 1993 is based on an Administration estimate of $321,700,000, and the addition of $30,000,000 for the continued development of technologies in support of the commercial launch vehicle industry. The authorization for fiscal year 1994 is based on an Administration estimate of $317,200,000, and the addition of $50,000,000 for the continued development of technologies in support of the commercial launch vehicle industry.

Program description

The overall goal of the Space Research and Technology program is to ensure continued U.S. leadership in space by providing advanced, enabling technologies, validated at a level suitable for user-readiness, for future space missions. To achieve this goal, a broad base of advanced technology is required for vehicle and subsystem concepts, components, devices, and software. This is achieved by developing technical strengths in the engineering disciplines within NASA, industry, and academia and performing critical technology validations that facilitate the transfer of new technology with a high level of confidence to future space missions.

Committee view

R&D Support for Commercial Launch Vehicle Industry

The Committee continues to be concerned with the lack of progress over the past four years in establishing a focused program to develop and expand technologies that would be of value to the commercial launch vehicle industry within the United States.

The Committee has often noted the tremendous value that NASA's research and development initiatives have provided the commercial aircraft industry. These initiatives have been invaluable in helping to develop and maintain this key industry as the largest and most dynamic in the world. As such, this industry continues to provide the largest positive contribution to this country's balance of payments than any other industrial sector.

As in the past, the Committee continues to believe that the research and development support that NASA has long provided to the commercial aircraft industry in this country provides an excellent model for the type of support that NASA should provide to the commercial launch vehicle industry.

The commercial launch vehicle industry in this country finds itself at a distinct disadvantage when trying to compete in the world marketplace. In large part, this disadvantage has been due to the research and development and technical support that other countries have provided to their launch vehicle industries.

This Committee believes that NASA should take steps to assist the commercial launch vehicle industry in this country to become more competitive in the world marketplace. To assist in this effort, the Committee has provided funds that could be used to establish a focused program of developing the propulsion, guidance and control, vehicle, ground support and other technologies that could benefit the commercial launch vehicle industry in this country.

The Committee is aware of a study conducted by the Department of Transportation's Commercial Space Transportation Advisory Committee which recommends a similar component technology program. The Committee recommends that this be considered as a basis for the NASA effort. Further close cooperation between NASA and DOT on this issue would be highly beneficial.

Flight Telerobotic Servicer

The Flight Telerobotic Servicer (FTS) was a teleoperated robotic system that was being developed for use in the assembly and maintenance of Space Station Freedom. The critical design review (CDR) for the FTS demonstration test flight (DTF-1) was completed in the fall of 1990. However, the Space Station program office decided to delete the FTS development from the Space Station program. In the fiscal year 1992 budget request, NASA has transferred the FTS program to the Space Research and

Technology budget line. It would account for the majority of the funding requested for space automation and robotics in fiscal year 1992. NASA has indicated that it will review the current FTS program plan to see whether it should be modified. The Committee believes that since the original mission of the FTS has been eliminated, the NASA telerobotics program should be structured in a way that maximizes the long-term technological gains to be realized from the program. In addition, the program should contribute to the development of U.S. commercial capabilities in teleoperated robotic systems. Two other areas in which research and development activity could provide real benefits are in teleoperated Space Station or free-flyer payload technologies, and in the development of micro rover and other microtechnolgy applications for lunar and planetary exploration.

The Committee therefore reduces the funding requested for the FTS program by $30,000,000. Of the remaining $25,000,000, $10,000,000 is transferred to the Research and Technology Base, and the balance is provided for research on telerobotics, teleoperated payload technologies, and for research on applications of microtechnology to robotic space exploration.

SECTION 4(a)(1)(O) EXPLORATION ACTIVITIES

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$ 67,000,000
1993	$ 88,000,000
1994	$102,400,000

Committee Recommendation:

Fiscal Year:	
1992	$ 67,000,000
1993	$ 88,000,000
1994	$102,400,000

Committee authorization recommendation

Section 4(a)(1)(O) authorizes $61,000,000 in fiscal year 1992. The reduction from the President's request for FY 1992 shall be accommodated by means of a general reduction of $6,000,000. Section 4(a)(1)(O) also authorizes $88,000,000 in fiscal year 1993, and $102,400,000 in fiscal year 1994 for Exploration Activities.

Program description

The Exploration Activities budget line funds Exploration Technology and Exploration Mission Studies. The Exploration Technology program is intended to develop advanced technologies that will support not only the Space Exploration Initiative (SEI), but will also be applicable to other areas of the nation's civil space effort.

Exploration mission studies are intended to develop the preliminary technical, scientific, and programmatic data needed to allow future decisions on the proper approach to human and robotic exploration of the Moon and Mars. In fiscal year 1992, the Exploration Mission Studies are to incorporate the findings of the Synthesis Group's studies into its analyses.

Committee views

SP-100 Reactor Program

The SP-100 program is a joint activity of NASA, the Department of Defense, and the Department of Energy. The objective of the program is to develop a space nuclear power system. Since the program was initiated in the early 1980s, it has undergone several rephasings and the milestones have been delayed. The Committee is concerned that NASA's exploration requirements are not adequately addressed in the SP-100 program, especially since NASA's requirements include the capability to provide power on planetary surfaces under harsh conditions, whereas the Department of Defense requirements are focussed more on the development of an in-space system. The Committee would like to be kept informed about the status of the exploration-related aspects of the SP-100 program and how the exploration-related requirements for the program are being addressed.

Synthesis Group

The Synthesis Group has been examining alternative approaches to the conduct of the Space Exploration Initiative. The Synthesis Group is scheduled to report its findings in April 1991. The Committee is interested in how NASA will respond to the report of the Synthesis Group and how NASA proposes to incorporate the findings into its Exploration Technology and Mission Studies activities. The Committee directs NASA to provide a report to the Committee on its response to the findings and recommendations of the Synthesis Group, as well as its plans for incorporating those findings into its activities in fiscal year 1992. The Committee requests that the report be delivered to Congress within six months of the release of the Synthesis Group's report.

SECTION 4(a)(1)(P) SAFETY, RELIABILITY & QUALITY ASSURANCE

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$33,600,000
1993	$32,500,000
1994	$34,000,000
Committee Recommendation:	
Fiscal Year:	
1992	$33,600,000
1993	$32,500,000

1994.....$34,000,000

Committee authorization recommendation

Section 4(a)(1)(P) authorizes $33,600,000 in fiscal year 1992 for Safety, Reliability, and Quality Assurance activities. This authorization is equal to the President's request.

Section 4(a)(1)(P) also authorizes $32,500,000 in fiscal year 1993 and $34,000,000 in fiscal year 1994 for Safety, Reliability, and Quality Assurance activities. These authorization levels are equal to the Administration's estimates.

Program description

The Safety, Reliability, and Quality Assurance program within NASA is intended to reduce the overall level of risk within the Agency's projects and activities. This is accomplished through such activities as the conduct of independent assessments, reviews, analyses, studies, and tests; the establishment of standards and guidelines; and the development of new inspection technologies, techniques, and devices.

SECTION 4(a)(1)(Q) ACADEMIC PROGRAMS

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:

1992.....$64,600,000
1993.....$70,500,000
1994.....$74,500,000

Committee Recommendation:

Fiscal Year:

1992.....$64,600,000
1993.....$70,500,000
1994.....$74,500,000

Committee authorization recommendation

Section 4(a)(1)(Q) authorizes the amounts contained in the President's request for fiscal years 1992 through 1994.

Program description

NASA's Academic Programs conduct aerospace educational programs and activities to inspire and support, in elementary through graduate school, students to prepare themselves for careers in science, engineering and technology. Funding initiated in fiscal year 1992 will allow for the continuation of the current program including the continuation of the Graduate Student Researchers program at the Kennedy Space Center.

Committee views

Educational Goals of the Human Exploration Program

The Committee has considered NASA's contribution to the Nation's educational system one of the greatest benefits and highest priorities of the space program. The recent recognition of an overall decline in American educational standards compared to other industrialized nations makes this priority all the more important.

The Committee notes and commends the establishment of education as one of the long term goals of the Space Exploration Initiative. The Committee further recognizes that present extrapolations of the science and engineering Phd work force necessary to carry out a robust Space Exploration Initiative falls short of what will be needed. Therefore, the Committee believes that NASA should undertake all practicable measures to assess and remedy this shortfall. These may entail a combination of societal educational programs aimed at secondary educational levels together with direct academic research programs which provide graduate and post graduate employment opportunities.

SECTION 4(a)(1)(R) TRACKING AND DATA ADVANCED SYSTEMS

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year 1992	$22,000,000
Fiscal Year 1993	$23,200,000
Fiscal Year 1994	$24,600,000

Committee Recommendation:

Fiscal Year:	
1992	$22,000,000
1993	$23,200,000
1994	$24,600,000

Committee authorization recommendation

Section 4(a)(1)(R) authorizes the appropriation of $22,000,000 in fiscal year 1992, $23,200,000 in fiscal year 1993, and $24,600,000 in fiscal year 1994 for Tracking and Data Advanced Systems.

Program description

The Tracking and Data Advanced Systems program provides for higher performance, higher reliability, and more cost-effective tracking and data handling capabilities for future space missions. This program is the research and development component of the Office of Space Operations, which runs the ground and space networks and the control and data acquisition facilities supporting all space flight missions.

SECTION 4(a)(2)(A) SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$1,288,900,000
1993	$1,277,000,000
1994	$1,210,500,000

Committee Recommendation:

Fiscal Year:	
1992	$1,358,900,000
1993	$1,277,000,000
1994	$1,210,500,000

Committee authorization recommendation

Section 4(a)(2)(A) authorizes $1,358,900,000 in fiscal year 1992 to support Shuttle Production and Operational Capability. This represents an increase of $70,000,000 above the President's request. This increase is the combined effect of: a $30,000,000 increase in Orbiter Operational Capability to provide additional support to maintain the readiness of the Orbiter production line and related production activities of Orbiter sub-contractors; a $50,000,000 increase in Propulsion Systems reflecting a transfer in this amount from the Construction of Facilities account to the Advanced Solid Rocket Motor program; and a $10,000,000 decrease in Assured Shuttle Availability deferring development of the Multifunction Electronic Display System. The Advanced Solid Rocket Motor program is authorized funding of $375,000,000.

Section 4(a)(2)(A) also authorizes $1,277,000,000 in fiscal year 1993 and $1,210,500,000 in fiscal year 1994 for Shuttle Production and Operational Capability. These authorization levels are equal to the Administration's estimates. However, the Committee questions the accuracy of these estimates given the lack of funding they provide for the Advanced Solid Rocket Motor program.

The Committee recognizes that the funds provided in fiscal year 1992 may not be sufficient to meet the needs of authorized Space Shuttle Production and Operational Capability programs. The Committee also recognizes that there may be additional funding flexability wihin the Space Shuttle Operations account. Accordingly, the Committee would entertain a request to transfer funds from the Space Shuttle Operations account into the Space Shuttle Production and Operational Capability account.

Program description

The objectives of the Shuttle Production and Operational Capability program are to provide for necessary design modifications and safety improvements to support the Space Shuttle; needed capabilities at the

launch site and for the flight operations process; continued development and testing of propulsion systems; and replacement of obsolete systems to ensure the long-term viability of the Shuttle program.

Committee view

Orbiter Production Readiness

In 1989, the Committee directed NASA to develop a long-range plan for handling the production line for Space Shuttle Orbiters. The Committee expressed increasing concern for the lack of such a policy and the resulting year-to-year nature of NASA's plans for this important production capability. NASA was directed to develop this long-range plan and submit it to the Congress by March 1, 1990.

The Committee finally received an "interim report" on NASA's efforts to produce such a plan on August 10, 1990. The Committee was informed that it would receive a completed detailed plan by October 1990. The Committee still has not received this completed plan.

The Committee is concerned that this continual lack of definitive action on the part of the Administrator may threaten the viability of the Orbiter production line through the loss of key prime contractor and sub-contractor capabilities.

The Committee has stated in the past that it could understand a decision by NASA to close down this production line if it were consciously made and well supported. On the other hand, simply permitting this production line and those of its sub-contractors to atrophy because of indecision and inaction is not in the public interest.

Accordingly, the Committee has taken action to preserve this production capability by once again authorizing an augmentation of funding support for structural spares and maintaining the readiness of the Orbiter production line and related production activities of Orbiter sub-contractors.

The Committee expects NASA to move with all deliberate speed in completing the Committee-directed long-range plan for the Space Shuttle production line. Until the completion and acceptance of this plan by the Congress, NASA should take whatever steps are required to preserve this production capability until a decision is reached regarding how it should be handled over the long term.

SECTION 4(a)(2)(B) SPACE SHUTTLE OPERATIONS

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$3,023,600,000
1993	$3,059,800,000

1994.....$3,161,200,000
Committee Recommendation:
Fiscal Year:
1992.....$2,970,600,000
1993.....$2,968,800,000
1994.....$2,897,200,000

Committee authorization recommendation

Section 4(a)(2)(B) authorizes $2,970,600,000 in fiscal year 1992 for Space Shuttle Operations. This represents a decrease of $53,000,000 below the President's request. This decrease is a result of the combined effect of: a $14,000,000 reduction in operating costs due to the cancellation of the Flight Telerobotic Servicer Space Shuttle mission in 1994, cancellation of the Space Shuttle "Flight Opportunity" in 1995, and movement of the Aeroassist Flight Experiment Space Shuttle mission from 1995 to 1996; and a $39,000,000 reduction in operating costs due to anticipated efficiencies in the Space Shuttle program consistent with a goal of four percent savings per year in operating costs. The $39,000,000 reduction in operating costs is based on an assumed four percent savings minus the $85,000,000 savings reduction that has already been made by the Office of Management and Budget.

Section 4(a)(2)(B) also authorizes $2,968,800,000 in fiscal year 1993 and $2,897,200,000 in fiscal year 1994 for Space Shuttle Operations. The authorization for fiscal year 1993 is based on an Administration estimate of $3,059,800,000 and a reduction of $91,000,000. This reduction is the result the combined effect of: a $46,000,000 reduction in operating costs due to the cancellation of the Flight Telerobotic Servicer Space Shuttle mission in 1994, cancellation of the Space Shuttle "Flight Opportunity" in 1995, and movement of the Aeroassist Flight Experiment Space Shuttle mission from 1995 to 1996; and a $45,000,000 reduction in operating costs due to anticipated efficiencies in the Space Shuttle program consistent with a goal of four percent savings per year in operating costs. The $45,000,000 reduction in operating costs is based on an assumed eight percent savings minus the $217,000,000 savings reduction that has already been made by the Office of Management and Budget.

The authorization for fiscal year 1994 is based on an Administration estimate of $3,161,200,000 and a reduction of $264,000,000. This reduction is the result the combined effect of: a $73,000,000 reduction in operating costs due to the cancellation of the Flight Telerobotic Servicer Space Shuttle mission in 1994, cancellation of the Space Shuttle "Flight Opportunity" in 1995, and movement of the Aeroassist Flight Experiment Space Shuttle mission from 1995 to 1996; and a $191,000,000 reduction in operating costs due to anticipated efficiencies in the Space Shuttle program consistent with a goal of four percent savings per year in operating costs. The $191,000,000 reduction in operating costs is based on an assumed twelve percent savings minus the $214,000,000 savings reduction that has already been made by the Office of Management and Budget.

Program description

Space Shuttle Operations provides for Space Shuttle launch services for NASA payloads, and, on a reimbursable basis, for those of the Department of Defense, other civil agencies, and certain commercial and international users. Within this account, flight hardware is produced, refurbished, and repaired; and manpower, propellants, and other materials are furnished to conduct and support both flight and ground operations. Operations funding also provides for the purchase of replacement spares for both flight and ground support hardware as existing inventories of spare parts are consumed as a result of flight-related activities.

Committee view

Cost Savings In the Space Shuttle Program

Two years ago, this Committee directed NASA to conduct a study to determine what efficiencies could be adopted within the Space Shuttle program to help offset the cost growth in excess of one billion that has occurred in the last several years. As stated in H.R. 1759,the National Aeronautics and Space Administration Multiyear Authorization Act of 1989, H. Rept. 101-226, the Committee encouraged NASA managers to be vigilant for changes in organization, procedures, operations, staffing, hardware design, etc. which could result in a reduction in the funds required to support the Space Shuttle program while causing no reduction in quality and safety.

The Committee report which NASA submitted in April 1990 in response to this requirement largely contained initiatives that have been in existence for a long time, some of which even predated the Challenger accident.

The Committee continues to believe that it should be possible to achieve savings in the Space Shuttle program without sacrificing quality and safety. This belief been reinforced by recent testimony to this Committee by key NASA officials.

For example, the Deputy Administrator testified on February 7, 1991 that it should be possible to reduce the annual cost of operating the Space Shuttle by 20 to 25 percent. Subsequently, on March 6, 1991, NASA's Associate Administrator for Space Flight testified that a 25 percent reduction in Space Shuttle operating costs could be taken as a goal and that he anticipated that a target for achieving that goal would be to achieve savings of three to five percent per year for about five years. He added that the savings would have to be achieved this way in order to maintain safety.

The Committee strongly supports this continued emphasis that NASA is placing on maintaining quality and safety within the Space Shuttle program. Additionally, the committee also supports whatever actions NASA can take to achieve cost savings within this program without jeopardizing quality and safety. In this regard, the committee believes that the Associate Administrator for Space Flight's anticipated target of achieving three to

five percent savings for a period of five years is a reasonable goal.

The Committee directs NASA to report to the Congress by March 1, 1992 on exactly how it would begin to achieve this annual cost savings of three to five percent in the Space Shuttle program.

SECTION 4(a)(2)(C) EXPENDABLE LAUNCH VEHICLES AND SERVICES

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$341,900,000
1993	$281,000,000
1994	$315,800,000

Committee Recommendation:

Fiscal Year:	
1992	$317,900,000
1993	$259,000,000
1994	$309,800,000

Committee authorization recommendation

Section 4(a)(2)(C) authorizes $317,900,000 in fiscal year 1992 for Expendable Launch Vehicles and Services. This represents a $24,000,000 decrease below the President's request reflecting the Committee's deletion of funding for the MSAT launch vehicle.

Section 4(a)(2)(C) also authorizes $259,000,000 in fiscal year 1993 and $309,800,000 in fiscal year 1994 for Expendable Launch Vehicles and Services. The authorization for fiscal year 1993 is based on an Administration estimate of $281,000,000 and a decrease of $22,000,000 reflecting the Committee's deletion of funding for the MSAT launch vehicle. The authorization for fiscal year 1994 is based on an Administration estimate of $315,800,000 and a decrease of $6,000,000 reflecting the Committee's deletion of funding for the MSAT launch vehicle. The Committee notes that it questions the accuracy of these estimates given the lack of funding they provide for the purchase of launch vehicles for TDRS-G, AXAF, CRAF, and Lifesats.

Program description

Funding for Expendable Launch Vehicles and Services provides launch services for unmanned civil U.S. government space missions that do not require the Space Shuttle's unique capabilities. Consistent with the Commercial Space Launch Act, Public Law 98-575, as amended, expendable launch vehicle services are to be acquired from the U.S. private sector whenever possible.

Committee view

Deletion of Funding for the MSAT Launch Vehicle

The Committee has deleted the funding intended to pay part of the cost of a launch vehicle for the mobile communications satellite (MSAT) planned by the American Mobile Satellite Corporation (AMSC). The Committee notes that a recent U.S. Court of Appeals decision has effectively rescinded the license granted to this corporation by the Federal Communications Commission (FCC). The court found that the FCC was acting at the periphery of its authority and did not demonstrate truly compelling reasons for forcing the applicants for a mobile satellite communications license into a single consortium.

Given this situation, it appears that the FCC will have to reconsider the license applications for mobile satellite service, a process which may take some time. As such, approval of this funding would be premature and the purpose for which this funding is intended may change significantly. Furthermore, the Committee believes that it would be preferable for federal agencies interested in obtaining mobile satellite services to purchase such services directly from AMSC or other providers as required, not through NASA or using funds from NASA's budget. The Committee does not believe that NASA should serve as a federal coordinator for operational services offered by commercial telecommunications firms.

SECTION 4(a)(2)(D) SPACE AND GROUND NETWORKS, COMMUNICATIONS, AND DATA SYSTEMS

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year 1992	$953,873,000
Fiscal Year 1993	$1,066,000,000
Fiscal Year 1994	$1,077,500,000

Committee Recommendation:

Fiscal Year:	
1992	$ 920,873,000
1993	$1,066,000,000
1994	$1,077,500,000

Committee authorization recommendation

Section 4(a)(2)(D) authorizes the appropriation of $920,873,000 in fiscal year 1992, $1,066,000,000 in fiscal year 1993, and $1,077,500,000 in fiscal year 1994 for Space and Ground Networks, Communications, and Data Systems. The $33,000,000 general reduction in fiscal year 1992 is without prejudice and may be absorbed by the elimination of the payment to the Federal Financing Bank for the Tracking and Data Relay Satellite System (TDRSS).

Program description

This program provides vital tracking, telemetry, command, data

acquisition, communications, and data processing support to meet the requirements of all NASA flight projects. In addition, support is provided on a reimbursable basis for projects of the Department of Defense, other Government agencies, commercial firms, other countries, and international organizations.

Committee views

Adequacy of Funding

The Committee is concerned about this program's ability to adequately support the large number of missions scheduled for the 1990s given the requested budget levels. The delay in the launch of the Earth Observing System and the restructuring of the space station have led some requirements to slip. Nevertheless, the Committee believes that delaying planned improvements of aging and inefficient equipment may threaten NASA's ability to support future space flight missions in a cost-effective manner and result in greater long-term costs for developing and operating ground systems.

Advanced Tracking and Data Relay Satellite

The Committee notes that NASA has taken several positive steps in the fiscal year 1992 budget request. The cancellation of funding for the Tracking and Data Relay Satellite (TDRS) Flight 8 spacecraft and the shift of TDRS Flight 7 to an expendable launch vehicle, actions recommended by this Committee, are particularly noted. At the same time, the Committee notes with concern that the start of procurement for the Advanced Tracking and Data Relay (ATDRS) has been further delayed.

The Committee views the ATDRS series as an opportunity to establish a more efficient and cost-effective tracking and data relay network. The Committee believes that ATDRS should take advantage of advanced technologies where they promise better performance at lower cost, as long as the technical and programmatic risks are consistent with an operational project. The Committee also believes that the operational nature of the ATDRS series promises significant cost savings. The high reliability of commercial communications satellites procured under fixed-price contracts suggests that this approach might lower the Government's procurement costs. In particular, the Committee notes that the Navy is procuring its UHF Follow-On satellites under a commercial-like contract. The UHF Follow-On contractor will build the satellites under a fixed-price contract, procure launch services, and deliver the satellites to the Navy on-orbit.

The Committee recognizes that high technical risk or the need to make changes to the specifications or design during the development phase would make a cost-plus contract more appropriate. However, the Committee also recognizes that high technical risk and poorly defined performance specifications are incompatible with an operational program. The Committee believes that NASA should not be in the business of engineering operational communications satellites and should, to the extent practicable and

reasonable, provide the potential contractors with performance specifications rather than detailed design specifications. Accordingly, the Committee urges NASA to carefully consider the potential advantages of procuring ATDRS under a fixed-price contract. As a minimum, the Committee believes that NASA should consider an arrangement whereby the first ATDRS satellite is procured on a cost-plus basis and additional models procured on a fixed-price basis. The Committee also intends that NASA take all possible steps to reduce the time currently planned for evaluating the ATDRS proposals and selecting a contractor. The time currently allotted to this activity appears to exceed what would be considered reasonable and customary for other procurements of operational spacecraft.

SECTION 4(A)(3) CONSTRUCTION OF FACILITIES

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$480,300,000
1993	$469,800,000
1994	$541,600,000

Committee Recommendation:

Fiscal Year:	
1992	$430,300,000

Committee authorization recommendation

Section 4(a)(3) authorizes $430,300,000 for "Construction of Facilities." This authorization represents a $50,000,000 reduction in the Administration's request, reflecting a transfer in that ammount from the Advanced Solid Rocket Motor project to the Space Shuttle Production and Operational Capability account. The Committee intends to continue to authorize institutional programs on an annual basis in order to more closely monitor specific expenditures and to ensure that these programs remain responsive to evolving agency needs.

The authorization bill drafted by NASA for fiscal year 1992 reduces the total of the amounts authorized for "Construction of Facilities" by $5,700,000 to $480,300,000 because of expected changes by the administration to the Davis-Bacon Act. NASA's action reflects the President's Budget statement for fiscal year 1992 that endorsed regulatory and legislative reform of the Davis-Bacon Act, including raising the threshold for contracts subject to the Act's provisions from $2,000 to $250,000.

The Davis-Bacon Act of 1931, Public Law 798, 71st. Cong., as amended, requires that construction contracts entered into by any agency of the Federal Government specify minimum wages to be paid to the various classes of laborers and mechanics employed under those contracts. The term "construction" includes direct construction, and the alteration or repair of public buildings and public works, including painting and decorating.

While the Davis-Bacon Act has enjoyed considerable support in Congress since its enactment, Congress has also devoted a significant amount of time to reviewing the Act in the past three decades. Changes to the Act during this time, however, have been minimal.

Accordingly, it is the Committee's intention that if the savings NASA expects from legislative and regulatory changes to the Davis-Bacon Act do not materialize, NASA shall absorb any shortfall from within amounts authorized under section 4(a)(3)(U) through (Y).

Program description

Section 4(a)(3) authorizes appropriations for contractual services for the repair, rehabilitation, and modification of existing facilities to maintain, upgrade, and improve the usefulness of the NASA physical plant; the construction of new facilities and the acquisition of related facility equipment needed to support science, space technology, and aeronautical research; environmental compliance and restoration activities; the design of facilities projects; and advanced planning related to future facilities needs.

The projects and amounts in the budget estimates reflect requirements for Space Station Freedom and Space Flight facilities, including the Advanced Solid Rocket Motor Program, that are time-sensitive to meet certain specific program objectives. Other program requirements for fiscal year 1992 include modernization of the industrial area chilled water system rehabilitation, and expansion of the communications duct banks, and replacement of the 15 kilowatt load break switches at the Kennedy Space Center; repair of the site water system at the White Sands Test Facility; replacement of two central plant chillers and a boiler at the Johnson Space Center; completion of modifications to the X-Ray Calibration Facility in support of the advanced X-Ray Astrophysics Facility (AXAF) at the Marshall Space Flight Center; restoration and modernization of the high voltage distribution system and construction of a data information system facility in support of the Earth Observing System (EOS) program at the Goddard Space Flight Center; modernization of the main electrical substation at the Jet Propulsion Laboratory; continuation of restoration of utilities at the Wallops Flight Facility; projects to repair, restore, and modernize NASA's aeronautical research and development facilities at Ames, Lewis, and Langley Research Centers; and construction of a data interface facility and rehabilitation of the Tracking and Data Relay Satellite System (TDRSS) ground terminal at the White Sands Test Facility in New Mexico.

The fiscal year 1992 program continues to meet the objectives of preserving and enhancing the capabilities and usefulness of existing facilities and ensuring safe, economical, and efficient use of the NASA physical plant. This request continues the necessary rehabilitation and modification program begun in prior years and continues a responsive repair program. The repair program restores facilities to a condition substantially equivalent to their originally designed capability. The minor construction program continues to provide a means to accomplish

smaller facility projects which accommodate changes in technical and institutional requirements. The environmental compliance and restoration program ensures that statutory environmental requirements are met and any necessary remedial actions are promptly taken.

Funds requested for facility planning and design cover advance planning for potential future projects, master planning, facilities studies, engineering reports and studies and the preparation of facility project design drawings and bid specifications.

* Language highlighted in this section is to be added by the Technology and Competitiveness Subcommittee.

Committee view

Construction of Space Station processing facility

NASA's budget for fiscal year 1992 requests funding for the construction of the Space Station processing facility in the amount of $35,000,000. This is the second increment of funding for the project. In fiscal year 1991, NASA received funding for this project in the amount of $12,000,000.

The Committee congratulates NASA on obtaining a bid for the construction of the Space Station processing facility that is less than the $89,500,000 total project cost estimated by NASA. To ensure that the project is completed in the optimum time, however, the Committee intends to authorize the full amount originally estimated by NASA. But it is the Committee's intention that any budget authority not needed by NASA for the construction of the Space Station processing facility should be applied to construct an office building for its employees who are currently employed in trailers at Kennedy Space Center.

SECTION 4(a)(4) RESEARCH AND PROGRAM MANAGEMENT

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$2,452,300,000
1993	$2,492,600,000
1994	$2,495,400,000

Committee Recommendation:

Fiscal Year:	
1992	$2,422,300,000

Committee authorization recommendation

Section 4(a)(4) authorizes $2,422,300,000 for F.Y. 1992. A reduction of $30,000,000 has been made without prejudice and may be absorbed by deferral of those costs associated with moving the NASA headquarters location. The Committee will continue to authorize Research and Program Management on an annual basis.

SECTION 4(a)(5) INSPECTOR GENERAL

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$14,600,000
1993	$15,300,000
1994	$15,700,000

Committee Recommendation:

Fiscal Year:	
1992	$14,600,000
1993	$15,300,000
1994	$15,700,000

Committee authorization recommendation

Section 4(a)(5) authorizes funding in the full amount of the President's request for activities undertaken by the Inspector General in fiscal years 1992 through 1994.

SECTION 5: CONSTRUCTION OF FACILITIES REPROGRAMMING

SECTION 6: SPECIAL REPROGRAMMING AUTHORITY FOR CONSTRUCTION OF FACILITIES

SECTION 7: CONSIDERATION BY COMMITTEES

SECTION 8: SMALL BUSINESS INNOVATION RESEARCH PROGRAM

SECTION 9: OFFICE OF FACILITIES MAINTENANCE

SECTION 10: COMMERCIAL SPACE LAUNCH ACT AMENDMENT

Section 10 authorizes the appropriation of $5,104,000 in fiscal year 1992 for the Office of Commercial Space Transportation. This amount is identical to the President's request for this office.

SECTION 11: NATIONAL SPACE COUNCIL AUTHORIZATION

Section 11(a) authorizes the appropriation of $1,491,000 in fiscal year 1992 to carry out the activities of the National Space Council established by section 501 of the NASA Authorization Act, Fiscal Year 1989 (42 U.S.C. 2471).

Section 11(b) expresses the sense of Congress that the National Space Council should develop policy recommendations for the follow-on program to Landsat 6.

SECTION 12: OFFICE OF SPACE COMMERCE AUTHORIZATION

Section 12 authorizes the appropriation of $491,000 in fiscal year 1992 for the Office of Space Commerce.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
BUDGET SUMMARY
In Millions of Dollars

	FY 1991	FY 1992 AUTHORIZATION		FY 1993 AUTHORIZATION		FY 1994 AUTHORIZATION		
	Approp	Pres Rqst	House Auth	Pres Est	House Auth	Pres Est	House Auth	Comments
RESEARCH AND DEVELOPMENT	6,023.6	7,198.5						
Space Station	1,900.0	2,028.9		2,426.0		2,790.8		
Space Transportation Capability Dev.	602.5	879.8	629.8	999.8	724.8	997.4	722.4	Consideration of New Launch Sys Deferred to a later date
Upper Stages	82.2	108.5	(-20)					Defer Centaur funding pending DOD negotiation
Spacelab	129.3	150.2	(-10)					Defer some hardware replacement
Engineering & Technical Base	208.5	235.2	(-15)					Slow rate of growth
Payload Operations & Supp. Equip.	101.5	144.5	(-15)					Defer some Space Station support
Tethered Satellite System	21.9	12.6						
Advanced Programs	35.2	53.8	(-15)					Defer increased emphasis on personnel transportation system
New Launch System	23.9	175.0						
Space Science and Applications	2,429.6	2,934.6						
Physics and Astronomy	975.1	1,140.6	1,096.6	1,321.4	1,241.4	1,308.5	1,248.5	
Gamma Ray Observatory Dev.	22.0	0.0						
Advanced X-Ray Astrophysics Fac.	101.2	211.0	(-50)		(-80)		(-60)	Slow rate of growth for S/C & Mirror funding
Global Geospace Science	96.6	65.3						
Shuttle/Spacelab Payload Mission Mgmt	88.8	88.0						
Space Station Utilization	3.0	0.0						
Payload & Instrument Dev.	94.6	115.9	(+6)					Develop flt opportunities for deleted Station attached payloads
Explorer Development	99.8	107.9						
Mission Operation & Data Analysis	313.3	388.4						
Research & Analysis	100.8	103.1						
Suborbital Program	55.0	61.0						
Life Sciences	138.0	183.9	183.9	284.0	224.0	326.1	246.1	
Human Space Flight & System Eng.	81.1	89.7						$2 million earmarked for coop activities on Mir
Research & Analysis	56.9	79.2						
Lifesat	(2.0)	15.0			(-60)		(-80)	Reduce growth rate in out-years
Planetary Exploration	457.1	627.3	299.3	635.3	251.9	643.5	263.4	
Ulysses Development	3.0	0.0						
Mars Observer	78.5	54.4						
Mars Balloon Relay Experiment	1.5	1.2						
CRAF/Cassini	145.0	328.0	(328.0)		(383.4)		(380.1)	CRAF/Cassini previously authorized in P.L. 101-611
Mission Operations & Data Analysis	161.2	150.5						
Research & Analysis	67.9	93.2						
Space Applications	859.4	962.8						
Earth Science & Applications	667.9	775.6	725.6	1,108.0	830.0	1,562.5	950.5	
Earth Observing System	191.0	336.0	(-75)		(-278)		(-612)	Defer some increase pending technical review
Earth Probes	54.7	68.2	(+15)					Increase emphasis on this program
Remotely Piloted Aircraft	0.0	5.0						
Upper Atmosphere Research Satellite	64.0	18.2						
Ocean Topography Experiment	76.0	51.9						
Payload & Instrument Development	49.7	48.6						
Missions Operations & Data Analysis	39.4	56.3	(+5)					$4 million for activity deferred from '91; $1 million to convert classified remote sensing data
			(+5)					$5 million for purchase of Landsat data
Research & Analysis	193.1	191.4	115.8	201.4	201.4	233.6	233.6	Transfer $6 million to Physics/Astronomy Payload & Instrument Development; $4 million gereral reduction
Materials Processing	102.3	125.8	(-10)					
Communications	52.5	39.4	39.4	34.7	34.7	31.1	31.1	
Information Systems	36.7	42.0	42.0	0.0	0.0	0.0	0.0	Out year activities absorbed by other accounts

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
BUDGET SUMMARY
In Millions of Dollars

	FY 1991	FY 1992 AUTHORIZATION		FY 1993 AUTHORIZATION		FY 1994 AUTHORIZATION		
	Approp	Pres Rqst	House Auth	Pres Est	House Auth	Pres Est	House Auth	Comments
Commercial Programs	86.0	150.8						
Technology Utilization	24.4	32.0	27.0 (-5)	31.7	29.7 (-2)	33.0	33.0	General reduction to reduce rate of growth
Commercial Use of Space	61.6	118.0	95.0 (-23)	144.2	132.2 (-12)	137.4	130.4 (-7)	General reduction to reduce rate of growth
Aeronautical Research and Technology	512.0	591.2	T&C	670.5	T&C	716.0	T&C	
Transatmospheric Res. & Tech. (NASP)	95.0	72.0	T&C	120.0	T&C	145.0	T&C	
Space Research & Technology	(255.9)	(354.8)	324.8	321.7	351.7	317.2	367.2	
Research & Technology Base	125.7	141.6	(+10)		(+30)		(+50)	Establish commercial ELV R&D initiative
In-Space Flight Experiments	11.2	16.0						
Civil Space Technology Initiative	119.0	114.3						
Space Automation & Telerobotics	(22.2)	82.9	(-40)					Delete FTS & restructure A&T program
Exploration Activities	(34.5)	(67.0)	61.0 (-6)	88.0	88.0	102.4	102.4	General reduction
Exploration Technology	27.5	52.0						
Exploration Mission Studies	7.0	15.0						
Safety, Reliability & Qual. Assurance	33.0	33.6	33.6	32.5	32.5	34.0	34.0	
Academic Programs	55.1	66.6	66.6	70.5	70.5	74.5	74.5	
Tracking & Data Advanced Systems	20.0	22.0	22.0	23.2	23.2	24.6	24.6	
SPACE FLIGHT, CONTROL & DATA COM.	5,124.4	5,608.3						
Shuttle Production & Ops. Cap.	1,276.4	1,288.9	1,358.9	1,277.0	1,277.0	1,210.5	1,210.5	
Orbiter Operational Capability	275.6	273.8	(+30)					Additional support for Orbiter production line
Propulsion Systems	747.8	622.7	(+50)					Xfer from Coff; ASRM authorized at $375 million for '92
Launch & Mission Support	253.0	270.1						
Assured Shuttle Availability	0.0	122.3	(-10)					Defer Multifunction Electronic Display System
Space Shuttle Operations	2,790.0	3,023.6	2,970.6	3,059.8	2,968.8	3,161.2	2,897.2	Delete FTS flt in 94, Flt Oppty & AFE flt in 95; Anticipate
			(14;-39)		(-46;-45)		(-73;-191)	Shuttle efficiency of 4% per year
Flight Operations	801.5	912.5						
Flight Hardware	1,393.3	1,417.0						
Launch and Landing Operations	595.2	694.1						
Expendable Launch Vehicles	229.2	341.9	317.9 (-24)	281.0	259.0 (-22)	315.8	309.8 (-6)	Delete NASA funding for NSAT launch vehicle
Space & Ground Networks, Com.	828.8	953.9	920.9 (-33)	1,066.0	1,066.0	1,077.5	1,077.5	General reduction
Space Network	310.1	348.0						
Ground Network	260.7	291.7						
Communications & Data Systems	258.0	314.2						
CONSTRUCTION OF FACILITIES	497.9	480.3	430.3 (-50)	469.8		541.6		Xfer ASRM equipment to ASRM R&D account
RESEARCH AND PROGRAM MANAGEMENT	2,211.9	2,452.3	2,422.3 (-30)	2,492.6		2,495.4		General reduction
INSPECTOR GENERAL	10.5	14.6	14.6	15.3	15.3	15.7	15.7	
TOTAL	13,868.3	15,754.0	*****	17,174.4	*****	18,295.3	*****	
			12,195.9		9,822.1		9,972.4	

Mr. HALL. Okay. We have some members who have some time requirements and we are going to try to honor those.

We continue with the markup of the NASA Authorization Bill of 1991. That markup will be limited to the Space Station and the New Launch System, since all other matters were disposed of yesterday.

I understand some members have some remarks they wish to make before we open the bill to amendment. Mr. Zimmer, I think, has a time problem. We recognize you and respect your time problem at this time.

Mr. ZIMMER. Thank you very much, Mr. Chairman. I do appreciate it. I do have floor duty for which I have to leave soon. But I have left a proxy asking that I be recorded in the negative on the amendment to provide for the authorization for Space Station Freedom.

I want to make clear that I sought assignment on the Space Committee because I fervently believe in the importance of space exploration and space research. I never believed that my first vote as a subcommittee member would be in opposition to a major component of the Space Program. I salute your efforts and the efforts of the other dedicated members of this committee and elsewhere in the House who have struggled and wrestled with this issue for years. But I have reluctantly concluded that Space Station Freedom, as currently conceived, is not worth its $30 billion price tag, and that our Space Program would be better served if the money was directed elsewhere in space research.

Public confidence in NASA must be maintained if the Space Program is to succeed. My greatest fear is that we might spend $30 billion on a Space Station only to have Americans come to regard it as an orbiting boondoggle, inadequate for its mission and overpriced for its capabilities.

The General Accounting Office recently completed a review of the budget history of the Space Station and it observed that since 1984, when it was originally proposed, capabilities declined while costs soared and the date for permanently manned capabilities has slipped from 1994 to 1999. As restructured, the Space Station is no longer likely to be used for observation, for servicing, or for staging Lunar or Mars missions.

We had some discussion during the hearing about the Space Studies Board, and with all due respect to the representatives of NASA, I believe we are talking about more than a quibble over the centrifuge. The Space Studies Board, in my way of thinking, made some very profound and fundamental criticisms of the new restructuring. For example, they pointed out the Space Station will cost 20 times for microgravity research what NASA spends on microgravity research today. Because of insufficient power and reduced crew size and lack of dedicated space, most life science research will be impeded and rudimentary microgravity requirements can't be met.

Access to the Space Station will be subject to the vulnerability of our shuttle fleet. The Augustine Report points to a clear danger of another shuttle disaster and while the astronauts may be prepared for that risk, the American public is not. The American public is not prepared to pay for hardware in Earth orbit that we can't use.

I don't intend to bash NASA or the contracting community. In fact, NASA has met every requirement placed on it by the Congress, and the contracting community has responded remarkably well time and time again to new design mandates. The fault for our predicament lies principally with Congress and its insistence on micromanagement. I don't know of any other nation in the world which would design a Space Station in an appropriations subcommittee instead of allowing scientists and engineers to do it.

The burgeoning cost of the Space Station threatens to divert money from a host of other small but essential space exploration projects. It is for this reason, Mr. Chairman, that I can't support this appropriation, because it fails to meet our basic objectives in space. Thank you very much.

[The prepared statement of Mr. Zimmer follows:]

Statement of Congressman Dick Zimmer, R-NJ
April 11, 1991

Mr. Chairman, I intend to vote against the authorization for Space Station Freedom. I sought assignment to the Space Subcommittee because I fervently believe in space exploration and research. I never dreamed that my first major vote as a subcommittee member would be in opposition to a major component of the space program. I salute the dedicated efforts of my colleagues who have wrestled with this issue for years, but I have reluctantly concluded that Space Station Freedom as currently conceived is not worth its $30 billion pricetag and that our space program would be better served if the money was directed elsewhere.

Public confidence in NASA must be maintained if the space program is to succeed. My greatest fear is that we might spend $30 billion on the space station only to have Americans come to regard it as an orbiting boondoggle, inadequate for its mission and overpriced for its capabilities.

The General Accounting Office recently completed its study on the budget history of the space station. It observed that, since 1984, when originally proposed, capabilities declined while costs soared. The date for permanently manned capability also slipped from 1994 to 1999.

As restructured, the space station will no longer be used for observation, servicing, or staging for lunar and Mars missions.

Meanwhile, on March 15, the National Academy of Sciences' Space Studies Board released its opinion of the restructured space station from a purely scientific point of view. The board adopted the Augustine Committee's recommendation that the space station be developed with top priority given to life sciences research and microgravity research. The board concluded that these priorities were not going to be met with the restructuring, and that the space station would be a poor investment in terms of the science performed.

In microgravity research, for example, the space station will cost 20 times what NASA spends on microgravity research today. Insufficient power, reduced crew size and lack of dedicated space would impede most life sciences research, while rudimentary microgravity requirements cannot be met.

Access to the space station will be subject to the vulnerability of our shuttle fleet. The Augustine Report points to a clear danger of another shuttle disaster and, while the astronauts may be prepared for that risk, the American public is not. It is not prepared to pay for hardware in earth orbit that we cannot use.

With respect to the space station, NASA has met every requirement placed upon it by Congress. The contracting community has responded remarkably well time and time again to new design mandates. The fault for our predicament lies more with Congress and its insistence on micromanagement. I cannot conceive of another nation which would design a space station in an appropriations subcommittee instead of allowing scientists and engineers to do it.

The burgeoning cost of the space station threatens to divert money from a host of other small, but essential, space exploration projects. It is for this reason, Mr. Chairman, that I cannot support this authorization, which fails to meet our basic objectives in space.

Mr. HALL. I thank the gentleman from New Jersey. I think your observations indicate your genuine interest in space and in the program and a very thoughtful probing of it. You have evidenced that you have done a lot of your homework. I disagree with you, but certainly respect the fact you have shown the courage to lay it on the line as to where you are.

Mr. ZIMMER. Thank you.

Mr. HALL. Your wishes and thoughts and input into this subcommittee are certainly appreciated.

Mr. ZIMMER. Thank you.

Mr. HALL. Are there others who want to make a statement?

[No response.]

[The prepared statements of Mr. Mineta and Mr. Packard follow:]

APRIL 11, 1991
NORMAN Y. MINETA, M.C.

NORMAN Y. MINETA, M.C.

MR. CHAIRMAN, I CONGRATULATE YOU ON HOLDING THIS LONG-AWAITED HEARING ON NASA'S SPACE STATION RESTRUCTURING PLANS, AND I CONGRATULATE YOU AND MR. LEWIS ON YOU HARD WORK ON THE NASA MULTIYEAR AUTHORIZATION ACT OF 1991.

MR. CHAIRMAN, THE AUGUSTINE REPORT HAS AFFORDED US AN OPPORTUNITY TO REESTABLISH OUR PRIORITIES IN SPACE AND CRYSTALIZE PUBLIC ATTENTION AND SUPPORT BEHIND A REINVIGORATED SPACE PROGRAM.

HOWEVER, THE UNITED STATES' FUTURE IN SPACE DEPENDS HEAVILY ON THE SPACE STATION -- AND I HAVE SERIOUS MISGIVINGS ABOUT NASA'S CURRENT PLANS FOR THE RESTRUCTURED SPACE STATION.

I AM CONCERNED PRIMARILY THAT THE STATION WILL NEVER REACH PERMANENT MANNED CAPABILITY BECAUSE OF THE LACK OF AN ASSURED CREW RETURN VEHICLE, AND I AM DISAPPOINTED THAT THE LIFE SCIENCES PROGRAM IS BEING POSTPONED AND DOWNSCALED AS A RESULT OF THE SPACE STATION RESTRUCTURING. BOTH OF THESE PROGRAMS ARE VITAL TO THE UNITED STATES' FUTURE IN SPACE.

MR CHAIRMAN, I HAVE ALWAYS BEEN A STRONG SUPPORTER OF THE U.S. SPACE PROGRAM, AND I BELIEVE THAT IT IS VERY IMPORTANT TO SUPPORT A STRONG AUTHORIZATION BILL THAT IS IN LINE WITH FISCAL REALITIES.

I WILL VOTE TO APPROVE THIS AUTHORIZATION THAT INCLUDES PLANS FOR THE RESTRUCTURED STATION BECAUSE I REMAIN CONVINCED THAT WITH HARD WORK BY NASA AND THE COMMITMENT OF THIS COMMITTEE AND CONGRESS AS A WHOLE, WE WILL CONTINUE CARRY OUT THE VISION THAT ALWAYS HAS BEEN THE DRIVING FORCE BEHIND THE NATION'S SPACE PROGRAM.

THANK YOU.

STATEMENT OF
THE HONORABLE RON PACKARD (R-CA)
SPACE SUBCOMMITTEE
MARKUP OF THE NASA AUTHORIZATION
ACT OF 1991
11:00 A.M., 2325 RHOB
APRIL 11, 1991

THANK YOU MR. CHAIRMAN FOR SCHEDULING THE PRECEDING HEARING WHICH GAVE US VALUABLE INFORMATION FOR THE MARKUP TODAY. THIS MARKUP, WHICH CONTINUES THE PROCESS THAT WAS INITIATED YESTERDAY, CONSISTS OF TWO CONTROVERSIAL PORTIONS OF THE NASA BILL. MR. CHAIRMAN, I WILL CONCLUDE BY SAYING THAT I AM READY TO GET TO WORK ON THIS BILL.

Mr. HALL. Okay. We will get into the amendments. Section 4(a)(1)(A)—the Space Station—is now open for amendment. I have an amendment contained in the amendment package. I don't know how it got to be Amendment 1, but it is. I will get underway with it at this time if I might.

My amendment, Amendment 1, is at page 5, lines 15–23, where we amend subparagraph (A) to read as follows, and basically what is does is provide $1.9 billion in fiscal year 1992, and also sets aside $25 million for a crew rescue vehicle. In addition, we give NASA $128 million pending the submission to us of reports showing six things. Basically those six things are an evaluation of the overall development and operating costs of the restructured station; a review of the potential to evolve the station beyond the man-tended configuration and beyond the permanently man-tended capability; an assessment of the potential and options for performing life sciences on the station prior to the year 2000; an assessment of the transportation options for the station assembly and resupply, including the role of the heavy lift launch vehicles; an assessment of the logistics and maintenance requirements for the restructured station; and an assessment of the ability of the restructured design to support utilization activities.

Basically that's what my amendment does.

[The amendment offered by Mr. Hall follows:]

HALLTX007

AMENDMENT TO THE SUBCOMMITTEE PRINT
OFFERED BY MR. HALL

Page 5, lines 15 through 23, amend subparagraph (A) to read as follows:

(A) United States International Space Station Freedom, $1,900,000,000 for fiscal year 1992, of which $25,000,000 shall be for the development of an Assured Crew Return Vehicle, with an additional $128,900,000 authorized upon the submission of a report to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate on an independent engineering review of the Space Station restructuring by the Aeronautics and Space Engineering Board of the National Research Council.

Mr. HALL. I lay it open to any questions, suggestions or amendments to my amendment at this time, if any.

[No response.]

Mr. HALL. If not, I move adoption of the subcommittee amendment.

Is there objection?

[No response.]

Mr. HALL. Chair hears none, it's adopted.

Mr. ZIMMER. Mr. Chairman, I should like to be recorded in the negative.

Mr. HALL. We should let the record reflect that Mr. Zimmer disagrees with my amendment. And he is recorded as no.

Is there further objection?

[No response.]

Mr. HALL. All in favor say aye.

[Chorus of ayes.]

Mr. HALL. Opposed?

Mr. ZIMMER. No.

Mr. HALL. The ayes have it. The amendment is adopted.

We will go to the second amendment. This is an amendment to the subcommittee print, page 5 line 24 through page 6, line 2, where we amend subparagraph (B) to read as follows: "Space Transportation capability development, $679,800,000 for fiscal year 1992, of which $40 million will be for the development of the Space Transportation Main Engine and $10 million shall be for the conduct of studies to define the roles, missions and configuration of the New Launch System; $799,800,000 for fiscal year 1993, and $847,400,000 for fiscal year 1994 on the New Launch System."

I suggest that the plans are too late for the station and too early for Moon/Mars and the answer will be—we have the shuttle, we have EL. I think in regard to the $40 million, NASA has a four-year old program called Space Transportation Main Engine. I want to preserve that and keep some options for it.

[The amendment offered by Mr. Hall follows:]

HALLTX009

AMENDMENT TO THE SUBCOMMITTEE PRINT
OFFERED BY MR. HALL

Page 5, line 24 through page 6, line 2, amend subparagraph (B) to read as follows:

(B) Space transportation capability development, $679,800,000 for fiscal year 1992, of which $40,000,000 shall be for the development of the Space Transportation Main Engine and $10,000,000 shall be for the conduct of studies to define the roles, missions, and configuration of the New Launch System, $799,800,000 for fiscal year 1993, and $847,400,000 for fiscal year 1994.

Mr. HALL. At this time, I would lay this amendment open to any other amendments or substitutions.

The Chair recognizes the gentleman from California.

Mr. ROHRABACHER. Mr. Chairman, I have a substitute for your amendment I would like to offer at this time, which I believe the members have before them. Mr. Chairman, it seems to me the requirements for a New Launch System, NLS, is highly doubtful. As we heard today, when you asked for some specifics on this, what I heard in answer to your questions about the requirements was very nebulous.

The missions projected for this proposed launcher are far more in the future and are not well defined, as was made very clear by the answers you received. It seems to me that by proposing not only a continuation of research and not a start-up funding for NLS, you are indicating your agreement with that analysis. But I submit that even if there does turn out to be a solid requirement for a heavy lift booster that the NLS would not be the right way to address this specific requirement.

As you can see from the comparison sheet—and I have a comparison sheet my staff has prepared that I have passed out—there are better and less expensive alternatives that can be pursued if we really need a heavy lifter. From designs proposed by our country's major launch services, providers of a heavy lift booster could be developed for well under one- tenth the development cost of the NLS. The eventual advantage of the NLS—and there is an eventual advantage if the proposed missions still remain as foreseen right now, if those missions stay the same as projected 10 years into the future, yes, there may be lower operating costs for the NLS at that time.

But even then, it would not compensate for the NLS' huge up-front costs. As the charts show that I have provided, the total cost of putting three million pounds of payload into orbit over 10 years with the NLS are still more than double the costs of achieving the same feat with a commercially derived heavy lifter.

If someone knows what it is we are going to want to put up in terms of what we are going to want to do with three million pounds in orbit at a cost of $1,000 per pound and up, I have yet to hear what that exactly is, and all the answers have been nebulous as to what this is all about.

My proposal is this. If we are going to assume that we need heavy lift launch vehicles within the next 10 years, and that has not necessarily been proven, then rather than letting NASA keep the hugely expensive NLS program going, let's have NASA put the concept out to bid. Let our aerospace firms compete with their own design proposals to see who can meet the heavy lift requirements at the lowest price, taking operating costs into consideration. If after that bid process is finished, if NASA can convince the Congress that the NLS has won the fair contest and we can all look at the figures and look at the cost proposals and the cost of operating, then Congress can authorize the NLS if indeed it is the most cost-effective way of meeting these goals.

In the meantime, let's not keep spending the taxpayers' money on this entry right now that looks like it is a big loser, because it does not have to compete. Let's find out what the facts are, let's

find out what the costs are by comparing what the NLS is to what the alternatives are, rather than just freezing out the possibility of looking at the facts. This is why I offer my substitute, and would like to offer it for consideration by the committee.

[The substitute offered by Mr. Rohrabacher follows:]

ROHRAB017

SUBSTITUTE OFFERED BY MR. ROHRABACHER
TO THE AMENDMENT OFFERED BY MR. HALL

Page 5, line 24, through page 6, line 2, amend subparagraph (B) to read as follows:

(B) Space transportation capability development, $629,800,000 for fiscal year 1992, $724,800,000 for fiscal year 1993, and $722,400,000 for fiscal year 1994. The Administrator shall, within 30 days after the date of enactment of this Act, publish in the Federal Register a notice requesting submittal before July 1, 1992 of designs for a heavy lift launch vehicle by the commercial space launch vehicle industry. The Administrator shall not specify the design requirements of such vehicle, except that such vehicle shall--

(i) be capable of placing at least 160,000 pounds of payload into a 28.45 degree low Earth orbit of at least 100 nautical miles;

(ii) have a payload volume of at least 60 feet in length and 15 feet in diameter;

(iii) have a payload environment, including particulate levels, sound and vibration levels, thermal constraints, pressures, and load factors,

ROHRAB017

with performance specifications at least equivalent to those of the Space Shuttle cargo bay;

(iv) be capable of a flight rate of at least 3 flights per year; and

(v) be ready for initial launch by March 31, 1999.

The Administrator shall, by October 1, 1992, submit to Congress a report containing a determination of which of the designs submitted in response to the request under this subparagraph is the lowest cost design that meets the requirements of clauses (i) through (v). The determination of lowest cost shall be based on combination of the costs of development and the projected costs of operation of the vehicle for its first 30 flights.

NLS Program vs."Bubba" (Heavy-Lift Delta) and "Titan V"

All "Bubba" and "Titan V" Data from McDonnell Douglas and Martin Marietta

- Time Needed to Develop Booster
  - NLS First Flight 2002
  - "Bubba"/"Titan V" First Flight 1997

- Money Needed to Develop Booster
  - NLS Program $14 to $16 billion
    (Cost data from the Space Subcommittee Staff)
  - "Bubba"/"Titan V" $500 million - $1 billion
    (Includes cost of first flight)

- Payload to Low Earth Orbit
  - NLS Program 50 000 lbs./160 000 lbs.
    (Two rocket versions)
  - "Bubba"/"Titan V" 100 000 lbs.

- Payload Volume/Dimensions
  - NLS Program Shuttle cargo bay
  - "Bubba"/"Titan V" Shuttle cargo bay

- Cost Per Flight

NLS Program	$50 million 50 000 lb. payload vehicle $100 million 160 000 lb. payload vehicle
"Bubba"/"Titan V"	$300 million

- Yearly Flight Rate

NLS Program	Every two months or so
"Bubba"/"Titan V"	Maximum of every three months or so

- Estimated Cost -- Ten Years of Operation (30 Flights)
  3 Million Pounds to LEO -- 30 Flights for "Titan V" or "Bubba", 60 flights for core NLS

NLS Program	$20 -- $22 Billion
"Bubba"/"Titan V"	$9.5 -- $10 Billion

Costs include development of the vehicles.

Mr. HALL. The Chair recognizes Mr. Sensenbrenner.

Mr. SENSENBRENNER. Mr. Chairman, I move to strike the last word.

Mr. HALL. Without objection. The Chair recognizes you for five minutes or as much time as you need for such a suggestion.

Mr. SENSENBRENNER. It will be less than five minutes.

Mr. Chairman, I oppose this amendment for a couple of reasons. First of all, I think this effectively defunds the NLS. To do that at this time is premature. The NLS may very well end up being a non-starter, but this concept is so new that we really don't have the information and data to make a decision to defund the NLS at this point in time. Consequently, I think the NLS should go forward.

With respect to placing the Heavy Lift Delta and Titan V systems against the NLS which the gentleman from California is attempting to do, I think flies in the face of the Augustine Commission report. My recollection of what Mr. Augustine and his colleagues recommended was that a heavy lift vehicle using 1990s technology be developed so that we could go into the 21st century with something that was relatively modern.

Merely upgrading the Delta and the Titan V means we will be using 1960s technology to face the boosting capability problems of the 21st century. I think that would be a step backward. I would recognize that using the old technology that has already been developed and paid for will be cheaper than developing new technology, that is an argument in favor of the amendment of the gentleman from California. But I do think we should be looking forward rather than backward.

The final point is that the NLS is going to be constructed jointly in conjunction with the Department of Defense and NASA. It will be a vehicle that will be used both for civilian and military applications. For this subcommittee to go ahead today and say that NASA should not get involved in it will merely create a vacuum which our friends in the Armed Services Committee will eagerly jump into. As a result, the cutting edge of space technology will end up being on the military side rather than the civilian side, and that concerns me quite a bit. So I would hope the amendment will be defeated.

Mr. HALL. The gentleman's time has expired. The gentleman from California will be given a chance to answer that, of course. Are there others who have suggestions, statements, or request time?

The gentleman from Texas.

Mr. GEREN. I have a point of clarification from Mr. Sensenbrenner. You are opposing Mr. Rohrabacher's amendment to Mr. Hall's amendment?

Mr. SENSENBRENNER. Yes.

Mr. GEREN. According to Mr. Hall's amendment, if it is not amended?

Mr. SENSENBRENNER. Right.

Mr. HALL. Are there other inquiries?

Mr. Rohrabacher, do you care to be recognized at this time?

Mr. ROHRABACHER. Mr. Sensenbrenner, it is my understanding the Air Force does not want this. It is my understanding that the

Air Force does not want this, and for us to be, at the time when we have a $350 billion deficit, to be just moving forward without competitive bids for a project that may be able to meet nebulous goals which may be able to be met at a lower price with bids from the private sector and freeze out bids from the private sector, is totally unconscionable.

The fact is that a lot of the disagreement we have is not based on looking backwards or based on old technology, but instead is based on who really does have a forward looking strategy into the future, and based on what we can afford. What I am suggesting, and we all know that the X30 technology may change views on how to accomplish the goals we want to accomplish in space.

We have a great deal of research going on in single staged orbit right now in terms of not only the X30 but other proposals. These may change the way we want to accomplish our space goals. For us now to move forward and keep spending billions of dollars on what we may find out tomorrow to be unnecessary because of new developments in the X30 program and the Single Staged Orbit Program or may well be able to be accomplished by private bid in the meantime at billions of dollars less cost to the taxpayers I think is just absolutely ridiculous.

So I would propose that those of us who really want a vibrant Space Program and want to continue to have public support, we have to make sure every dollar we use is spent wisely. This is what we have seen are some of the problems. We didn't insist on that with the Space Station, and that is why we have seen basically billions of dollars wasted so far. We could have put our feet down earlier on and demanded responsible answers. I think this is the responsible approach, to insist on at least private bids, to accomplish the goals that are set out. Thank you very much.

Mr. HALL. Thank you, Mr. Rohrabacher.

Are there others who request time?

[No response.]

Mr. HALL. I recognize myself for about half a minute.

Actually—and I have high regard for the gentleman from California and his knowledge and obviously he has put an awful lot of work and thought into this amendment. But as the gentleman from New Jersey, Mr. Zimmer, said, we really shouldn't design the Space Station in an appropriations subcommittee. The gentleman from California's substitute is a very detailed list of specifications, when we really don't know what the mission will be.

My amendment simply recommends a funding stream for the STME that is roughly what the Administration had in mind a year ago, that is $40 million in fiscal year 1992 and $75 million in fiscal year 1993 and $125 million in fiscal year 1994. I would give the gentleman from California any time he wants to answer that. Basically, I think this would go back and throw it all open to industry and anyone else. I would urge we not adopt his substitute.

I recognize the gentleman from California at this time for any answers he may have.

Mr. ROHRABACHER. Well, if NASA was willing to set the specifics—any specific requirements—those requirements could be put out for bid. My proposal is basically talking about heavy lift requirements. I see nothing wrong with trying to determine what you

are trying to accomplish and then trying to find the most cost-effective way of achieving that goal.

The most cost-effective way of achieving the goal is not to freeze out competition and private bids and leave it up to some government committees to determine—and we have seen what has happened with the Space Station. I think if we are trying to save the taxpayers' dollars and accomplish what we need to accomplish in the most cost-effective manner, my substitute is the way to go.

Mr. HALL. All right. Are there other requests for time?

[No response.]

Mr. HALL. If not, the vote will be on the substitute by the gentleman from California. All in favor of the gentleman from California's substitute say aye.

[Chorus of ayes.]

Mr. HALL. Those opposed?

[Chorus of noes.]

Mr. HALL. In the opinion of the Chair the noes have it. The noes have it.

Mr. PACKARD. Mr. Chairman, before we vote on your amendment, I just have a point of inquiry, if I may?

On the budget summary sheet, it outlines or gives a figure under Space Transportation Capability Development of $629.8 million. In your figures you show $679.8. Could the staff enlighten me as to the discrepancy here and what is happening? An amendment of an increase is recommended?

Mr. HALL. Yes, there is an increase there. I recognize Dr. Smith to answer that.

Dr. SMITH. Thank you.

Mr. Packard, there were two items left open in the markup yesterday, the Space Station and the New Launch System. So the effect of this amendment would be to then act upon the section of NASA's bill dealing with the New Launch System. The request in that case was $175 million. The effect of the Chair's amendment is to——

Mr. PACKARD. To increase that by $40 million?

Dr. SMITH. Well, to provide $50 million.

Mr. PACKARD. I see.

Mr. HALL. Are there other inquiries?

[No response.]

Mr. HALL. Does the gentleman from California yield back his time?

Mr. PACKARD. So we are not changing any of the other subcategories of that basic category?

Mr. HALL. No.

Mr. PACKARD. In other words, we are still looking at a $20 million, and a $10 million, and a $15 million and a $15 million reduction?

Mr. HALL. If you will notice down there where it says "New Launch System"——

Mr. PACKARD. I do.

Mr. HALL [continuing]. The $175 million——

Mr. PACKARD. Yes.

Mr. HALL. And under the House authorization you put $50 million, I think that's the change. Does that satisfy the gentleman?

Mr. PACKARD. Plus $50 million. It would be a plus $50 million over the $175?

Dr. SMITH. No, Mr. Packard. It would be relative to the $175 million. What you would show, to be consistent with the rest of the spreadsheet, would be minus $125 million.

Mr. HALL. The request for the New Launch System was $175 million. What we are authorizing is $50 million.

Mr. PACKARD. I don't understand, then, why we have $50 million more in your request in that total category than we do on the spreadsheet.

Dr. SMITH. Mr. Packard, the spreadsheet was showing $629 million relative to NASA's request of $879 million. So the effect the amendment would be to change the $629 million to $679 million, relative again to the request of $879 million.

Mr. PACKARD. I see. Okay, thank you very much.

Mr. HALL. Are there other inquiries?

[No response.]

Mr. HALL. If not, I move the adoption of the amendment. Is there objection?

The Chair will hear one, I suppose, Mr. Zimmer—did he ask to be—not on this one. All right.

Is there objection?

[No response.]

Mr. HALL. The Chair hears none. The amendment is adopted.

Are there any further amendments before the subcommittee?

Mr. SENSENBRENNER. Mr. Chairman, if there are no further amendments, I move that the subcommittee report the bill as amended. Furthermore, I move to instruct the staff to prepare the subcommittee report to make technical and conforming amendments and that the Chairman take all necessary steps to bring the bill before the full committee for deliberation.

Mr. HALL. Would you hold for just a moment until we get some report language?

Mr. PACKARD. Before we get to the report language, I had some other questions. I don't necessarily have any amendments, but I would like to have clarification, so I know what we are doing.

Under the Earth Observing Systems, it shows a $75 million reduction. Listening to the panel this morning, I would like to hear from the staff as to the justification for the reduction in the EOS, if the chairman is willing. Dr. Smith would be fine.

Dr. SMITH. Mr. Packard, the report language accompanying the bill makes clear that we are taking the reduction in the Earth Observing System in view of the current technical review that has been mandated for the Earth Observing System. That will not be completed until later this year. The intent of the review, which is being done for NASA and the Space Council, is to look at alternatives and options to the current plan for the Earth Observing System, including the first platform. In view of the uncertainty as to what the scope of the Earth Observing System is intended to be, we have deferred that funding. I might also add, though, that in view of the length of the legislative process, it is possible that early results could be factored into the authorization bill.

Mr. PACKARD. So once that review is taken care of we will probably add this back in at a later date? At least that's an option?

Dr. SMITH. It's an option.

Mr. PACKARD. Also, Mr. Chairman, in reviewing the figures on the second page of the spread summary, I notice the third item is Commercial Use of Space, and we see a $23 million reduction there. Further down, down somewhat further near the bottom, I see Expendable Launch Vehicles, a $24 million reduction there, both of which I think are a little interrelated to the commercialization of our Space Program, and I think you are aware I have been very anxious and concerned about our efforts toward commercialization. I would again like a response from Dr. Smith as to the justification here and what it would do to our movement away from total dependence on shuttle or more involvement with a balanced fleet, including ELVs.

Mr. HALL. I will recognize Dr. Smith for that in just a moment, but we did make that amendment yesterday. I don't know if the gentleman was present——

Mr. PACKARD. I was, and I guess I——

Mr. HALL. We added $11 million back. In concurrence with the agreement of the committee we had to find a place to cut. We cut the expendable launch vehicles from $24 million, we extended their cut to $36 million. We lessened this $23 million to a $12 million cut. Let me let Mr. Smith, if you need further information than that, to give you further information. But that is basically what has happened.

Mr. PACKARD. I appreciate that response. That is adequate.

Mr. HALL. Okay.

Mr. PACKARD. The last item I had, Mr. Chairman, was what I brought up in this morning's hearing, the Assured Shuttle Availability, the justification for delaying the MDS system. I would be interested in knowing what the committee's justification for that $10 million reduction is.

Mr. HALL. While I am looking for it——

Mr. PACKARD. I beg your pardon. It is on the second page in the middle under the Space Flight Control Data, on Data Communications. It is Assured Shuttle Availability, $122 million recommended and $10 million reduction.

Mr. HALL. I think we simply slowed down the start, is what we were doing there. But I recognize the staff for any further clarification you might want.

Dr. SMITH. Mr. Hall is correct, we certainly did not eliminate it. We slowed it down and my recollection—perhaps Dr. Dawson would know the number—we have provided between $4 million and $5 million——

Dr. DAWSON. $4.8 million.

Dr. SMITH. It's $4.8 million for that program. The Assured Shuttle Availability program was one that in last year's authorization bill was very much supported by the subcommittee in our markup. We encourage the establishment of that program. As we looked at the program this year and reviewed the individual activities within the program there were a great many safety related issues, some performance related programs, and we looked very hard to see if there were any of those that could conceivably be deferred in view of the need to find an overall NASA budget that was within the budget reality, as explained yesterday.

Mr. PACKARD. Thank you, Mr. Chairman.

Mr. HALL. Thank you.

Is there other discussion of the report language? Is there any additional report language to be offered?

[Amendment offered by Mr. Hall to the Committee report follows:]

Amendment Offered by Mr. Hall
to the Committee Report

SECTION 4(a)(1)(A) SPACE STATION FREEDOM

Insert at the end of the Committee views on Space Station Freedom the following additional Committee view:

Engineering Review of the Space Station Restructuring

The Committee believes that the Space Station restructuring will have a significant impact on the future course of the program. The restructuring was completed and reviewed on an extremely tight schedule, and many aspects of the restructured program are not yet fully understood. The Committee therefore thinks it is imperative that an independent review of the Space Station restructuring be conducted. The Committee directs NASA to request that the Aeronautics and Space Engineering Board of the National Research Council conduct the review. The review should be submitted to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Comerce, Science, and Technology of the Senate by January 31, 1992. The review should address at least the following: (1) an evaluation of the overall development and operating costs of the restructured Station, as well as an examination of the adequacy of the reserves provided and identification of any unfunded requirements; (2) a review of the potential to evolve the Station beyond the man-tended configuration and beyond the permanently manned capability; (3) an assessment of the potential and options for performing life sciences on the Station prior to the year 2000; (4) an assessment of the transportation options for the Station assembly and resupply including the role of a heavy lift launch vehicle, (5) an assessment of the logistics and maintenance requirements for the restructured Station, (6) an assessment of the ability of the restructured design to support utilization activities.

[No response.]

Mr. HALL. If not, is there a motion to adopt the report language?

Mr. NAGLE. Mr. Chairman, I move that the proposed committee reviews be adopted by the subcommittee.

Mr. HALL. Is there objection?

[No response.]

Mr. HALL. The Chair hears none. The report language is adopted.

I recognize the gentleman from Pennsylvania.

Mr. SENSENBRENNER. Mr. Chairman, I now renew my motion to report the bill to the full committee.

Mr. HALL. Is the objection to the motion to report the bill to the full committee? There will be one objection. Mr. Zimmer will be registered as being in opposition to it.

All in favor say aye.

[Chorus of ayes.]

Mr. HALL. Opposed, no.

[No response.]

Mr. HALL. Let the record reflect there is one no, Mr. Zimmer.

Is there anything else for the good of the subcommittee and the committee as a whole and Congress in general that anyone has to offer?

Mr. NAGLE. Mr. Chairman, I think I share the feeling of many of the members, I personally appreciate, and I think the committee appreciates the fact that we done our markup this year, we have done it timely, and at the same time we have done it thoroughly and that's kind of a new tradition for us in this room, and all of us appreciate your effort in that regard.

[Applause.]

Mr. HALL. The Chair will yield you 15 more minutes. [Laughter.]

We are adjourned.

[Whereupon, at 12 noon, the subcommittee adjourned, to reconvene at the call of the Chair.]

[The final amendments as voted on by Subcommittee members follow:]

FINAL

SUBCOMMITTEE ON SPACE

Markup
Thursday, APRIL 11, 1991

LIST OF AMENDMENTS

1.	Mr. Hall	Space Station Voice vote: Adopted with one objection
2.	Mr. Rohrabacher	Substitute to Mr. Hall's NLS Amendment Voice vote: Defeated
3.	Mr. Hall	New Launch System Voice vote: Adopted without objection

REPORT LANGUAGE TO BE OFFERED AS COMMITTEE VIEWS

3.	Mr. Hall	Space Station Voice vote: adopted without objection

BILL REPORTED ON VOICE VOTE

1.

HALLTX007

AMENDMENT TO THE SUBCOMMITTEE PRINT
OFFERED BY MR. HALL

Page 5, lines 15 through 23, amend subparagraph (A) to read as follows:

(A) United States International Space Station Freedom, $1,900,000,000 for fiscal year 1992, of which $25,000,000 shall be for the development of an Assured Crew Return Vehicle, with an additional $128,900,000 authorized upon the submission of a report to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate on an independent engineering review of the Space Station restructuring by the Aeronautics and Space Engineering Board of the National Research Council.

ROLL CALL - SUBCOMMITTEE ON SPACE

SUBJECT: Hall amendment - Space Station

	Present	Absent	Yeas	Nays	Not Voting
Mr. Hall, Chrmn (D-TX)					
Mr. Sensenbrenner (R-WI)					
Mr. Volkmer (D-MO)					
Mr. Lewis (R-FL)					
Mr. Stallings (D-ID)					
Mr. Packard (R-CA)					
Mr. Traficant (D-OH)					
Mr. Rhodes (R-AZ)					
Mr. Perkins (D-KY)					
Mr. Henry (R-MI)					
Mr. McMillen (D-MD)					
Mr. Slaughter (R-VA)					
Mr. Nagle (D-Iowa)					
Mr. Smith (R-TX)					
Mr. Hayes (D-LA)					
Mr. Rohrabacher (R-CA)					
Mr. Tanner (D-TN)					
Mr. Zimmer (R-NJ)				✓	
Mr. Browder (D-AL)					
Mr. Garen (D-TX)					
Mr. Bacchus (D-FL)					
Mr. Cramer (D-AL)					
Mr. Schauer (D-NY)					
Mr. Mineta (D-CA)					
Mr. Torricelli (D-NJ)					
Ex officio Members Mr. Brown (D-CA)					
Mr. Walker (R-PA)					
TOTAL:	____	____	____	____	____

ATTEST: Adopted voice vote - without objection

Committee Secretary

2.

ROHRAB017

SUBSTITUTE OFFERED BY MR. ROHRABACHER
TO THE AMENDMENT OFFERED BY MR. HALL

Page 5, line 24, through page 6, line 2, amend subparagraph (B) to read as follows:

(B) Space transportation capability development, $629,800,000 for fiscal year 1992, $724,800,000 for fiscal year 1993, and $722,400,000 for fiscal year 1994. The Administrator shall, within 30 days after the date of enactment of this Act, publish in the Federal Register a notice requesting submittal before July 1, 1992 of designs for a heavy lift launch vehicle by the commercial space launch vehicle industry. The Administrator shall not specify the design requirements of such vehicle, except that such vehicle shall--

(i) be capable of placing at least 160,000 pounds of payload into a 28.45 degree low Earth orbit of at least 100 nautical miles;

(ii) have a payload volume of at least 60 feet in length and 15 feet in diameter;

(iii) have a payload environment, including particulate levels, sound and vibration levels, thermal constraints, pressures, and load factors,

with performance specifications at least equivalent to those of the Space Shuttle cargo bay;

(iv) be capable of a flight rate of at least 3 flights per year; and

(v) be ready for initial launch by March 31, 1999.

The Administrator shall, by October 1, 1992, submit to Congress a report containing a determination of which of the designs submitted in response to the request under this subparagraph is the lowest cost design that meets the requirements of clauses (i) through (v). The determination of lowest cost shall be based on combination of the costs of development and the projected costs of operation of the vehicle for its first 30 flights.

as substitute to Hall's NLS.

ROLL CALL - SUBCOMMITTEE ON SPACE

SUBJECT: Rohrabacher amendment - space transpo capability dev.

	Present	Absent	Yeas	Nays	Not Voting
Mr. Hall, Chrmn (D-TX)					
Mr. Sensenbrenner (R-WI)					
Mr. Volkmer (D-MO)					
Mr. Lewis (R-FL)					
Mr. Stallings (D-ID)					
Mr. Packard (R-CA)					
Mr. Traficant (D-OH)					
Mr. Rhodes (R-AZ)					
Mr. Perkins (D-KY)					
Mr. Henry (R-MI)					
Mr. McMillan (D-MD)					
Mr. Slaughter (R-VA)					
Mr. Nagle (D-Iowa)					
Mr. Smith (R-TX)					
Mr. Hayes (D-LA)					
Mr. Rohrabacher (R-CA)					
Mr. Tanner (D-TN)					
Mr. Zimmer (R-NJ)					
Mr. Browder (D-AL)					
Mr. Goren (D-TX)					
Mr. Bacchus (D-FL)					
Mr. Cramer (D-AL)					
Mr. Scheuer (D-NY)					
Mr. Mineta (D-CA)					
Mr. Torricelli (D-NJ)					
Ex-officio Members Mr. Brown (D-CA)					
Mr. Walker (R-PA)					
TOTAL	____	____	____	____	____

ATTEST: voice vote ordered

Committee Secretary

3.

HALLTX009

AMENDMENT TO THE SUBCOMMITTEE PRINT
OFFERED BY MR. HALL

Page 5, line 24 through page 6, line 2, amend subparagraph (B) to read as follows:

(B) Space transportation capability development, $679,800,000 for fiscal year 1992, of which $40,000,000 shall be for the development of the Space Transportation Main Engine and $10,000,000 shall be for the conduct of studies to define the roles, missions, and configuration of the New Launch System, $799,800,000 for fiscal year 1993, and $847,400,000 for fiscal year 1994.

ROLL CALL - SUBCOMMITTEE ON SPACE

SUBJECT: Hall amendment - New Launch System

	Present	Absent	Yeas	Nays	Not Voting
Mr. Hall, Chrmn (D-TX)					
Mr. Sensenbrenner (R-WI)					
Mr. Volkmer (D-MO)					
Mr. Lewis (R-FL)					
Mr. Stallings (D-ID)					
Mr. Packard (R-CA)					
Mr. Traficant (D-OH)					
Mr. Rhodes (R-AZ)					
Mr. Perkins (D-KY)					
Mr. Henry (R-MI)					
Mr. McMillen (D-MD)					
Mr. Slaughter (R-VA)					
Mr. Nagle (D-Iowa)					
Mr. Smith (R-TX)					
Mr. Hayes (D-LA)					
Mr. Rohrabacher (R-CA)					
Mr. Tanner (D-TN)					
Mr. Zimmer (R-NJ)					
Mr. Browder (D-AL)					
Mr. Geren (D-TX)					
Mr. Bacchus (D-FL)					
Mr. Cramer (D-AL)					
Mr. Scheuer (D-NY)					
Mr. Mineta (D-CA)					
Mr. Torricelli (D-NJ)					
Exofficio Members Mr. Brown (D-CA)					
Mr. Walker (R-PA)					
TOTAL:	____	____	____	____	____

ATTEST: voice vote adopted w/out objection

Connie Mansfield Sweeney

4.

Amendment Offered by Mr. Hall
to the Committee Report

SECTION 4(a)(1)(A) SPACE STATION FREEDOM

Insert at the end of the Committee views on Space Station Freedom the following additional Committee view:

Engineering Review of the Space Station Restructuring

The Committee believes that the Space Station restructuring will have a significant impact on the future course of the program. The restructuring was completed and reviewed on an extremely tight schedule, and many aspects of the restructured program are not yet fully understood. The Committee therefore thinks it is imperative that an independent review of the Space Station restructuring be conducted. The Committee directs NASA to request that the Aeronautics and Space Engineering Board of the National Research Council conduct the review. The review should be submitted to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Comerce, Science, and Technology of the Senate by January 31, 1992. The review should address at least the following: (1) an evaluation of the overall development and operating costs of the restructured Station, as well as an examination of the adequacy of the reserves provided and identification of any unfunded requirements; (2) a review of the potential to evolve the Station beyond the man-tended configuration and beyond the permanently manned capability; (3) an assessment of the potential and options for performing life sciences on the Station prior to the year 2000; (4) an assessment of the transportation options for the Station assembly and resupply including the role of a heavy lift launch vehicle, (5) an assessment of the logistics and maintenance requirements for the restructured Station, (6) an assessment of the ability of the restructured design to support utilization activities.

ROLL CALL - SUBCOMMITTEE ON SPACE

SUBJECT: Hall amendment to report - Space Station

	Present	Absent	Yeas	Nays	Not Voting
Mr. Hall, Chrmn (D-TX)					
Mr. Sensenbrenner (R-WI)					
Mr. Volkmer (D-MO)					
Mr. Lewis (R-FL)					
Mr. Stallings (D-ID)					
Mr. Packard (R-CA)					
Mr. Traficant (D-OH)					
Mr. Rhodes (R-AZ)					
Mr. Perkins (D-KY)					
Mr. Henry (R-MI)					
Mr. McMillen (D-MD)					
Mr. Slaughter (R-VA)					
Mr. Nagle (D-Iowa)					
Mr. Smith (R-TX)					
Mr. Hayes (D-LA)					
Mr. Rohrabacher (R-CA)					
Mr. Tanner (D-TN)					
Mr. Zimmer (R-NJ)					
Mr. Browder (D-AL)					
Mr. Geren (D-TX)					
Mr. Bacchus (D-FL)					
Mr. Cramer (D-AL)					
Mr. Scheuer (D-NY)					
Mr. Mineta (D-CA)					
Mr. Torricelli (D-NJ)					
Ex officio Members Mr. Brown (D-CA)					
Mr. Walker (R-PA)					
TOTAL:	____	____	____	____	____

ATTEST: adopted - voice vote

Anne Marie Sweeney

FULL COMMITTEE MARKUP OF THE NASA MULTIYEAR AUTHORIZATION ACT OF 1991

WEDNESDAY, APRIL 24, 1991

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, DC.

The committee met, pursuant to notice, at 10:10 a.m., in room 2318, Rayburn House Office Building, Hon. George E. Brown, Jr. (chairman of the committee) presiding.

45-073 O—91——28

(short)

BROWCA024

ELC

102D CONGRESS
1ST SESSION

H. R. ____

IN THE HOUSE OF REPRESENTATIVES

A BILL

To authorize appropriations to the National Aeronautics and Space Administration for research and development, space flight, control, and data communications, construction of facilities, research and program management, and Inspector General, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the ``National Aeronautics and Space Administration Multiyear Authorization Act of 1991''.

SEC. 2. FINDINGS.

Congress finds that--

(1) the report of the Advisory Committee on the Future of the United States Space Program has provided a framework within which a consensus on the goals of the space program can be developed;

(2) a balanced civil space science program should be funded at a level of at least 20 percent of the aggregate amount in the budget of the National Aeronautics and Space Administration for ``research and development'' and ``space flight, control, and data communications'';

(3) development of an adequate data base for life sciences in space will be greatly enhanced through closer scientific cooperation with the Soviet Union, including active use of manned Soviet space stations;

(4) the space program can make substantial contributions to health-related research and should be an integral part of the Nation's health research and development program;

(5) Landsat data and the continuation of the Landsat system beyond Landsat 6 are essential to the Mission to

BROWCA024

3

Planet Earth and other long-term environmental research programs;

(6) increased use of defense-related remote sensing data and data technology by civilian agencies and the scientific community can benefit national environmental study and monitoring programs;

(7) the generation of trained scientists and engineers through educational initiatives and academic research programs outside of the National Aeronautics and Space Administration is essential to carrying out a long-term Space Exploration Initiative;

(8) policies which restrict the use of foreign launch capabilities for United States Government satellites should apply only where adequate United States launch capabilities exist;

(9) the aeronautical program contributes to the Nation's technological competitive advantage, and it has been a key factor in maintaining preeminence in aviation over many decades; and

(10) the National Aero Space Plane program can have benefits to the military and civilian aviation programs from the new and innovative technolgies developed in propulsion systems, aerodynamics, and control systems that could be enormous, especially for high-speed aeronautical and space flight.

SEC. 3. POLICY.

It is the policy of the United States that--

(1) the Administrator of the National Aeronautics and Space Administration, in planning for national programs in environmental study and human space flight and exploration, should ensure the resiliency of the space infrastructure;

(2) a stable and balanced program of civil space science should be planned to minimize future year funding requirements in order to accommodate a steady stream of new initiatives;

(3) any new launch system undertaken or jointly undertaken by the National Aeronautics and Space Administration should be based on defined mission and program requirements or national policies established by Congress;

(4) in fulfilling the mission of the National Aeronautics and Space Administration to improve the usefulness, performance, speed, safety, and efficiency of space vehicles, the Administrator should establish a program of research and development to enhance the competitiveness and cost effectiveness of commercial expendable launch vehicles; and

(5) the National Aeronautics and Space Administration should promote and support efforts to advance scientific

understanding by conducting or otherwise providing for research on environmental problems, including global change, ozone depletion, acid precipitation, deforestation, and smog.

SEC. 4. AUTHORIZATION OF APPROPRIATIONS.

(a) AUTHORIZATIONS.--There are authorized to be appropriated to the National Aeronautics and Space Administration the following amounts:

(1) For ``research and development'', for the following programs:

(A) United States International Space Station Freedom, $1,900,000,000 for fiscal year 1992, of which $25,000,000 shall be for the development of an Assured Crew Return Vehicle, with an additional $128,900,000 authorized upon the submission of a report to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate on an independent engineering review of the Space Station restructuring by the Aeronautics and Space Engineering Board of the National Research Council.

(B) Space transportation capability development, $679,800,000 for fiscal year 1992, of which $40,000,000 shall be for the development of the Space

Transportation Main Engine and $10,000,000 shall be for the conduct of studies to define the roles, missions, and configuration of the New Launch System, $799,800,000 for fiscal year 1993, and $847,400,000 for fiscal year 1994.

(C) Physics and astronomy, $1,096,600,000 for fiscal year 1992, of which $6,000,000 shall be made available for carrying out scientific programs which have otherwise been eliminated from the Space Station, $1,241,400,000 for fiscal year 1993, and $1,248,500,000 for fiscal year 1994.

(D) Life sciences, $183,900,000 for fiscal year 1992, $224,000,000 for fiscal year 1993, and $246,100,000 for fiscal year 1994.

(E) Planetary exploration, $299,300,000 for fiscal year 1992, $251,900,000 for fiscal year 1993, and $263,400,000 for fiscal year 1994.

(F) Earth science and applications, $725,600,000 for fiscal year 1992, of which $5,000,000 shall be made available only for the purchase of Landsat data for global change research, and $1,000,000 shall be made available for remote sensing data conversion, $830,000,000 for fiscal year 1993, and $950,500,000 for fiscal year 1994.

(G) Materials processing in space, $115,800,000

for fiscal year 1992, $201,400,000 for fiscal year 1993, and $233,600,000 for fiscal year 1994.

(H) Communications, $39,400,000 for fiscal year 1992, $34,700,000 for fiscal year 1993, and $31,100,000 for fiscal year 1994.

(I) Information systems, $42,000,000 for fiscal year 1992.

(J) Technology utilization, $27,000,000 for fiscal year 1992, $29,700,000 for fiscal year 1993, and $33,000,000 for fiscal year 1994.

(K) Commercial use of space, $107,000,000 for fiscal year 1992, $138,200,000 for fiscal year 1993, and $134,400,000 for fiscal year 1994.

(L) Aeronautical research and technology, $591,200,000 for fiscal year 1992, $670,500,000 for fiscal year 1993, and $716,000,000 for fiscal year 1994.

(M) Transatmospheric research and technology, $72,000,000 for fiscal year 1992, $120,000,000 for fiscal year 1993, and $145,000,000 for fiscal year 1994.

(N) Space research and technology, $324,800,000 for fiscal year 1992, $351,700,000 for fiscal year 1993, and $367,200,000 for fiscal year 1994. Of such amounts, $10,000,000 in fiscal year 1992,

$30,000,000 in fiscal year 1993, and $50,000,000 in fiscal year 1994 shall be made available for carrying out a program of component technology development directed at commercial expendable launch vehicle competitiveness.

(O) Exploration activities, $61,000,000 for fiscal year 1992, $88,000,000 for fiscal year 1993, and $102,400,000 for fiscal year 1994.

(P) Safety, reliability, and quality assurance, $33,600,000 for fiscal year 1992, $32,500,000 for fiscal year 1993, and $34,000,000 for fiscal year 1994.

(Q) University Space Science and Technology Academic Program, $64,600,000 for fiscal year 1992, $70,500,000 for fiscal year 1993, and $74,500,000 for fiscal year 1994.

(R) Tracking and data advanced systems, $22,000,000 for fiscal year 1992, $23,200,000 for fiscal year 1993, and $24,600,000 for fiscal year 1994.

(2) For ''space flight, control, and data communications'' for the following programs:

(A) Space Shuttle Production and Operational Capability, $1,358,900,000 for fiscal year 1992, of which $375,000,000 shall be made available for the

BROWCA024

9

Advanced Solid Rocket Motor program, $1,277,000,000 for fiscal year 1993, and $1,210,500,000 for fiscal year 1994.

(B) Space Shuttle Operations, $2,970,600,000 for fiscal year 1992, $2,968,800,000 for fiscal year 1993, and $2,897,200,000 for fiscal year 1994.

(C) Launch Services, $305,900,000 for fiscal year 1992, $259,000,000 for fiscal year 1993, and $309,800,000 for fiscal year 1994.

(D) Space and ground networks, communications, and data systems, $920,873,000 for fiscal year 1992, $1,066,000,000 for fiscal year 1993, and $1,077,500,000 for fiscal year 1994.

(3) For ``construction of facilities'', including land acquisition, for fiscal year 1992 as follows:

(A) Construction of Space Station Processing Facility, Kennedy Space Center, $35,000,000.

(B) Modification for Earthquake Protection, Downey/Palmdale, CA, Johnson Space Center, $4,400,000.

(C) Modifications for Safe Haven, Vehicle Assembly Building, High-Bay 2, Kennedy Space Center, $7,500,000.

(D) Rehabilitation of Crawlerway, Kennedy Space Center, $3,000,000.

BROWCA024

10

(E) Restoration of Shuttle Landing Facility Shoulders, Kennedy Space Center, $4,000,000.

(F) Restoration of the High Pressure Gas Facility, Stennis Space Center, $6,500,000.

(G) Construction of Addition for Flight Training and Operations, Johnson Space Center, $13,000,000.

(H) Construction of Advanced Solid Rocket Motor Program Facilities (various locations), $100,000,000.

(I) Modernization of Industrial Area Chilled Water System, Kennedy Space Center, $4,000,000.

(J) Rehabilitation and Expansion of Communications Duct Banks, Kennedy Space Center, $1,400,000.

(K) Replace 15 KV Load Break Switches, Kennedy Space Center, $1,300,000.

(L) Repair Site Water System, White Sands Test Facility, $1,300,000.

(M) Replace Central Plant Chillers and Boiler, Johnson Space Center, $5,700,000.

(N) Modifications to X-Ray Calibration Facility (XRCF), Marshall Space Flight Center $5,200,000.

(O) Restoration and Modernization of High Voltage Distribution System, Goddard Space Flight Center, $7,000,000.

(P) Construction of Earth Observing System Data

BROWCA024

11

Information System Facility, Goddard Space Flight Center, $17,000,000.

(Q) Modernization of Main Electrical Substation, Jet Propulsion Laboratory, $5,500,000.

(R) Restoration of Utilities, Wallops Flight Facility, $3,500,000.

(S) Construction of Data Interface Facility, White Sands Test Facility, $4,000,000.

(T) Rehabilitation of Tracking and Data Relay Satellite System (TDRSS) Ground Terminal, White Sands Test Facility, $5,700,000.

(U) Repair of facilities at various locations, not to exceed $1,000,000 per project, $31,700,000.

(V) Rehabilitation and modification of facilities at various locations, not to exceed $1,000,000 per project, $34,800,000.

(W) Minor construction of new facilities and additions to existing facilities at various locations, not to exceed $750,000 per project, $12,900,000.

(X) Environmental compliance and restoration, $36,000,000.

(Y) Facility planning and design, not otherwise provided for, $34,000,000.

(Z) Repair and modernization of the 12-foot

Pressure Wind Tunnel, Ames Research Center, $25,000,000.

(AA) Upgrade of Outdoor Aerodynamic Research Facility, Ames Research Center, $3,300,000.

(BB) Modernization of 16-foot Transonic Tunnel, Langley Research Center $3,400,000.

(CC) Modifications to the High Pressure Air System, Langley Research Center, $11,700,000.

(DD) Rehabilitation of Central Air System, Lewis Research Center, $5,600,000.

(EE) Rehabilitation of Icing Research Tunnel, Lewis Research Center, $2,600,000.

Notwithstanding the amounts authorized in subparagraphs (A) through (EE), the total amount authorized by this paragraph shall not exceed $430,300,000.

(4) For ``research and program management'', $2,422,300,000 for fiscal year 1992.

(5) For ``Inspector General'', $14,600,000 for fiscal year 1992, $15,300,000 for fiscal year 1993, and $15,700,000 for fiscal year 1994.

(b) LIMITATIONS.--(1)(A) Notwithstanding paragraph (4), appropriations authorized under this section for ``research and development'' and ``space flight, control, and data communications'' may be used--

(i) for any items of a capital nature (other than

acquisition of land) which may be required at locations other than installations of the National Aeronautics and Space Administration for the performance of research and development contracts; and

(ii) for grants to nonprofit institutions of higher education, or to nonprofit organizations whose primary purpose is the conducting of scientific research, for purchase or construction of additional research facilities.

Title to facilities described in clause (ii) shall be vested in the United States unless the Administrator determines that the national program of aeronautical and space activities will best be served by vesting title in any such grantee institution or organization. Each such grant shall be made under such conditions as the Administrator shall determine to be required to ensure that the United States will receive therefrom benefit adequate to justify the making of that grant.

(B) None of the appropriations authorized under this section for ``research and development'' and ``space flight, control, and data communications'' may be used in accordance with this paragraph for the construction of any facility, the estimated cost of which, including collateral equipment, exceeds $750,000, unless the Administrator has notified the Committee on Science, Space, and Technology of the House of

Representatives and the Committee on Commerce, Science, and Transportation of the Senate of the nature, location, and estimated cost of such facility.

(2) Appropriations authorized under this section for ``research and development'', for ``space flight, control, and data communications'', or for ``construction of facilities'' may remain available until expended. Appropriations authorized under this section for ``research and program management'' for maintenance and operation of facilities, and for other services, shall remain available through the next fiscal year after the fiscal year for which such amount is appropriated.

(3) Not to exceed $35,000 of appropriations authorized under this section for ``research and program management'' may be used for scientific consultations or extraordinary expenses upon the approval or authority of the Administrator, and the Administrator's determination shall be final and conclusive upon the accounting officers of the Government.

(4)(A) Except as provided in paragraph (1)(A), appropriations authorized under this section for ``research and development'', ``space flight, control, and data communications'', or ``research and program management'' may be used for the construction of new facilities and additions to, or repair, rehabilitation, or modification of existing facilities, but only if the cost of each such project,

including collateral equipment, does not exceed $200,000.

(B) Except as provided in paragraph (1)(A), appropriations authorized under this section for ``research and development'' or ``space flight, control, and data communications'' may be used for unforeseen programmatic facility project needs, but only if the cost of each such project need, including collateral equipment, does not exceed $750,000.

(C) Appropriations authorized under this section for ``research and program management'' may be used for repair, rehabilitation, or modification of existing facilities controlled by the General Services Administration, but only if the cost of each such project, including collateral equipment, does not exceed $500,000.

SEC. 5. CONSTRUCTION OF FACILITIES REPROGRAMMING.

Appropriations authorized under section 4(a)(3)(A) through (EE)--

(1) may be varied upward 10 percent, in the discretion of the Administrator or the Administrator's designee; or

(2) following a report by the Administrator or the Administrator's designee to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate on the particular circumstances, may be varied

upward 25 percent to meet unusual cost variations. The total amount of appropriations authorized under section 4(a)(3)(A) through (EE) shall not be increased as a result of actions taken under paragraphs (1) and (2) of this section.

SEC. 6. SPECIAL REPROGRAMMING AUTHORITY FOR CONSTRUCTION OF FACILITIES.

Where the Administrator determines that new developments or scientific or engineering changes in the national program of aeronautical and space activities have occurred; and that such changes require the use of additional funds for the purposes of construction, expansion, or modification of facilities at any location; and that deferral of such action until the enactment of the next authorization Act would be inconsistent with the interest of the Nation in aeronautical and space activities; the Administrator may transfer not to exceed one-half of 1 percent of the funds appropriated pursuant to section 4(a)(1) or (2) to the ``construction of facilities'' appropriation for such purposes. The Administrator may also use up to $10,000,000 of the amounts authorized under section 4(a)(3) for such purposes. The funds so made available pursuant to this section may be expended to acquire, construct, convert, rehabilitate, or install permanent or temporary public works, including land acquisition, site preparation, appurtenances, utilities, and equipment. No such funds may be obligated until a period of

30 days has passed after the Administrator or the Administrator's designee has transmitted to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate a written report describing the nature of the construction, its cost, and the reasons therefor.

SEC. 7. CONSIDERATION BY COMMITTEES.

Notwithstanding any other provision of this Act--

(1) no amount appropriated pursuant to this Act may be used for any program deleted by the Congress from requests of the Administrator as originally made to either the Committee on Science, Space, and Technology of the House of Representatives or the Committee on Commerce, Science, and Transportation of the Senate;

(2) no amount appropriated pursuant to this Act may be used for any program in excess of the amount actually authorized for that particular program by section 4(a)(1), (2), and (4); and

(3) no amount appropriated pursuant to this Act may be used for any program which has not been presented by the Administrator to either such committee,

unless a period of 30 days has passed after the receipt by each such committee of notice given by the Administrator containing a full and complete statement of the action

BROWCA024

18

proposed to be taken and the facts and circumstances relied upon in support of such proposed action. The National Aeronautics and Space Administration shall keep the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate fully and currently informed with respect to all activities and responsibilities within the jurisdiction of those committees. Any Federal department, agency, or independent establishment shall furnish any information requested by either committee relating to any such activity or responsibility.

SEC. 8. SMALL BUSINESS INNOVATION RESEARCH PROGRAM.

The Administrator may utilize up to 5 percent of the funds provided for the Small Business Innovation Research Program pursuant to section 4(f) of the Small Business Innovation Development Act of 1982, for program management and promotional activities.

SEC. 9. OFFICE OF FACILITIES MAINTENANCE.

The Administrator shall create an Office of Facilities Maintenance, which shall have complete authority to plan and direct facilities maintenance management for all National Aeronautics and Space Administration sites.

SEC. 10. COMMERCIAL SPACE LAUNCH ACT AMENDMENT.

Section 24 of the Commercial Space Launch Act (49 U.S.C. App. 2623) is amended by adding at the end thereof the

BROWCA024

following: ``There are authorized to be appropriated to the Secretary to carry out this Act $5,104,000 for fiscal year 1992.''.

SEC. 11. NATIONAL SPACE COUNCIL AUTHORIZATION.

(a) There are authorized to be appropriated to carry out the activities of the National Space Council established by section 501 of the National Aeronautics and Space Administration Authorization Act, Fiscal Year 1989 (42 U.S.C. 2471), $1,491,000 for fiscal year 1992, of which not more than $1,000 shall be available for official reception and representation expenses. The National Space Council shall reimburse other agencies for not less than one-half of the personnel compensation costs of individuals detailed to it.

(b) It is the sense of Congress that the National Space Council, in coordination with the Committee on Earth and Environmental Sciences, should, by October 1, 1991, establish policy recommendations for carrying out the President's commitment to maintaining the continuity of Landsat data, including plans and programs for a succesor to Landsat 6, organizational options and recommendations for acquiring Landsat data for global change research, national security, environmental management, and other governmental purposes, and options and recommendations for encouraging the use of Landsat data by commercial firms and development of the commercial market for such data.

SEC. 12. OFFICE OF SPACE COMMERCE AUTHORIZATION.

There are authorized to be appropriated to the Secretary of Commerce for the Office of Space Commerce $491,000 for fiscal year 1992.

SEC. 13. AMENDMENT OF PUBLIC LAW 100-147.

Section 107(a) of the National Aeronautics and Space Administration Authorization Act of 1988 (P.L. 100-147) is amended--

(1) by inserting ``, in both then year and constant dollars,'' after ``estimated cost'';

(2) by inserting ``assembly (including related costs);'' after ``construction of facilities;''; and

(3) by adding at the end the following new sentence: ``Each such plan shall also include the estimated cost, in both then year and constant dollars, of operations for at least the first full year of steady operations of the space station.''.

SEC. 14. MULTIYEAR CONTRACTING.

Along with submission to Congress of the National Aeronautics and Space Administration fiscal year 1993 budget request, the Administrator shall--

(1) present a study which assesses the usefulness of granting similar authority as under section 2306(h) of title 10, United States Code, to the National Aeronautics and Space Administration; and

BROWCA024

(2) recommend no less than 5 candidate programs to be considered by Congress for multiyear contracting.

April 23, 1991 10:35 AM

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION MULTIYEAR AUTHORIZATION ACT OF 1991

REPORT

CONTENTS

Introduction.....
Purpose of the Bill.....
Legislative Reporting Requirements.....
Explanation of the Bill.....
Sectional Analysis.....
Committee Recommendations.....
Congressional Budget Office--Cost Estimate.....
Effects of Legislation on Inflation.....
Changes in Existing Law Made by the Bill as Reported.....
Oversight Findings and Recommendations.....
Oversight Findings and Recommendations of the Committee on Government Operations.....
Administration Recommendations:
NASA Request.....
DOT Request.....

INTRODUCTION

Over the next decade, the substantive efforts of the space program will be directed toward preparing a space infrastructure to carry out major initiatives in environmental study and human exploration. This infrastructure will include a system of Earth observing platforms together with a data management system, a manned Space Station, and a space transportation system. The Committee's review of the budget request for fiscal year 1992 and succeeding years has been carried out with the intent of ensuring that this infrastructure is resilient and based on a sound long range strategy.

Concurrent with this infrastructure development, NASA intends to execute a science strategic plan made up of large, intermediate, and small missions together with programs designed to utilize and enhance man related elements of the space program. The Committee's efforts have been directed at ensuring the stability of this strategic plan in a budgetary context and its responsiveness to broader scientific needs.

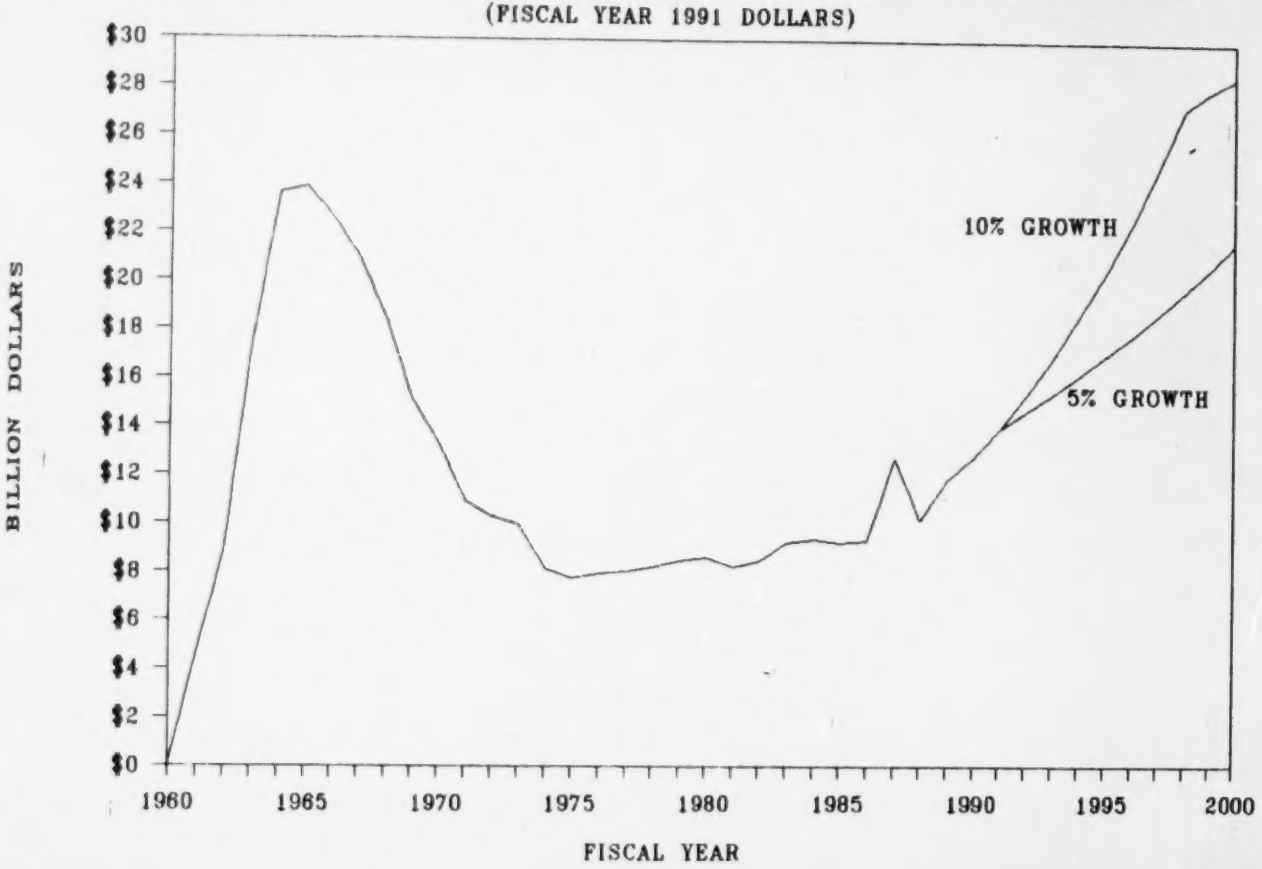
The Committee's consideration of the NASA request this year has also been carried out within the framework of the Report of the Advisory Committee on the Future of the U.S. Space Program. This report has provided a strong basis for developing a consensus on the long range goals and directions for the space program. As established in this report, such a consensus does not now exist and has been lacking since the Apollo program. As a result, the underlying rationale for the space program in the present budgetary, social, and political environment has received no serious consideration in nearly two decades and space policy has largely resulted from specific hardware initiatives and budgetary influences. Thus, ambitious extensions of the space program including renewed human exploration initiatives and major environmental monitoring efforts, should rightfully be reconsidered and based on a full understanding of the contemporary role of science and technology in the National agenda.

Key to sustaining the robust and balanced space program recommended by the Advisory Committee report is a consensus on a long-range stable and increasing budget. The budgetary growth recommended by the Report, an annual increase of 10 percent real growth, will lead to a doubling of the NASA budget before the year 2000 at which time the NASA budget will reach a level of 0.4 percent of the GNP. This approximates the average share of the GNP allocated to the space program during the Apollo era.

[figure 1]

Although this specific budget growth may be difficult to sustain over a long period, the Committee believes that some such steady commitment of at least half that growth rate is essential to expanding the space program beyond its present dimensions. If such a budget

FIGURE 1. GROWTH ENVELOPE FOR NASA



growth does not materialize and the space program remains at or near its present level, the present balance between science and infrastructure development and the long range intent of the manned program will need to be seriously reconsidered.

The Committee has provided a multiyear authorization for NASA's major programs in order to more realistically establish their budgetary requirements and has also developed guidelines in critical policy areas. A summary of major provisions of the bill is as follows:

- Funds for the Space Station have been provided, with some of the funding to be used for development of an Assured Crew Return Vehicle and some of the funding contingent on the delivery of a report on an independent engineering review of the Space Station restructuring.
- Funding for the New Launch System has been significantly reduced, with remaining funding focused on studies and a slower development pace for the Space Transportation Main Engine.
- General reductions have been applied in certain Space Transportation Capability Development programs with a view of restoring these funds in future fiscal years as their needs become better defined.
- The rate of increase in funding for spacecraft definition studies and instrument development for the Advanced X-Ray Astrophysics Facility has been slowed pending clearer demonstration of success in mirror metrology.
- Funding has been provided for alternative flight programs for those attached payloads that were deleted from the Station.
- Funding has been provided for life science activities on the Soviet Mir Space Station.
- Funding has been provided for the Lifesat new start, however, program growth in fiscal years 1993 and 1994 has been slowed.
- The rate of increase in funding for the Earth Observing System has been reduced pending completion of the current technical review.
- Funding has been added for Earth probes, classified remote sensing data conversion, and the Earth science data analysis activities which were deferred in fiscal year 1991.
- Funding has been provided for the purchase of Landsat data for Global Change research.
- Funding for Materials Processing in Space has been reduced based on the need to develop alternative flight programs for deleted Station attached payloads and also the need to better define the role of Station materials processing facilities that are scheduled to be delivered after the Permanent Manned Capability milestone, when Life Science activities should predominate.
- The rate of increase in funding for Commercial Use of Space has been reduced without prejudice.
- The rate of increase in funding for Technology Utilization has been reduced.
- A program of component technology development has been established in order to assist the commercial launch vehicle industry.
- In lieu of a Flight Telerobotic Servicer program, an automation and robotics technology program has been established emphasizing

teleoperated Space Station payload technologies and micro rover technologies for planetary exploration.

- A general reduction in Exploration Activities has been made without prejudice. The Committee reaffirms its strong support for a sustained Exploration program.
- Funding has been augmented for the Advanced Solid Rocket Motor program in order to allow it to support the Space Station requirements and schedule.
- Funding has been augmented to maintain an active Shuttle structural spares and Shuttle production support program.
- Work on the "glass cockpit" within the Assured Shuttle Availability Program has been reduced.
- Funding for two future Shuttle flights has been eliminated and one Shuttle flight has been delayed.
- Overall funding for Shuttle Operations has been reduced in anticipation of greater management and program efficiencies.
- Funding for expendable launch vehicle services for MSAT has been deleted pending clearer definition of the role of the MSAT consortium.
- A general reduction has been made to the Space and Ground Networks, Communications, and Data Systems program.
- Funds from the construction of the ASRM facility have been applied to the ASRM development program.
- A general reduction has been made to the Research and Program Management account.
- The sense of Congress has been expressed that the National Space Council should develop policy recommendations for the follow-on program to Landsat 6.

PURPOSE OF THE BILL

The purpose of the bill is to authorize appropriations to the National Aeronautics and Space Administration (NASA) for fiscal years 1992, 1993, and 1994, and to the Department of Transportation Office of Commercial Space Transportation, the Department of Commerce Office of Space Commerce, and the National Space Council within the Executive Office of the President. The bill also sets forth special policy provisions and authorities in order to carry out the activities of the civil space program. In summary, the bill provides the following budget authority:

AMOUNT OF NEW BUDGET AUTHORITY
[Millions of Dollars]

	Fiscal year 1992	Fiscal Year 1993	Fiscal Year 1994
National Aeronautics and Space Administration.....	$14,938.0	$10,693.6	$10,962.4
Department of Transportation Office of Commercial Space Transportation.....	$5.1		
Department of Commerce Office of Space Commerce.....	$0.5		
National Space Council.....	$1.5		

Summary of Committee Views

POLICY

Science Budget "Bow Wave".--The Committee is concerned that the future year budget requirements and projections resulting from the science programs requested in fiscal year 1992 are so large that no budget margin or new starts will be available.

SPACE STATION

Space Station Program Restructuring.--The Committee is concerned that the proposed restructuring of the Space Station will not achieve the original goals of the program.

Program Management.--The Committee is concerned that contemplated management changes may be disruptive and costly unless a clear long range transition plan is developed.

Engineering Review of the Space Station Restructuring.--The Committee directs NASA to request an independent engineering review of the Space Station restructuring plan.

PHYSICS AND ASTRONOMY

Deletion of Space Station Attached Payloads.--The Committee regrets NASA's deletion of the attached science payloads from the Space Station program and directs NASA to develop alternative means of conducting the experiments that were deleted.

Astronomy and Astrophysics in the 1990s.--The Committee urges NASA to give serious consideration to the findings and recommendations of the National Academy of Sciences' review of astronomy and astrophysics priorities for the 1990s when the Office of Space Sciences and Applications revises its strategic plan. The Committee also urges that the Small Explorer program be responsive to the needs of the investigators.

LIFE SCIENCES

Lifesat.--The Committee reduces NASA's runout for the Lifesat program and urges NASA to exert strong discipline over program costs.

Cooperative Research on Mir.--The Committee supports cooperative life sciences research on the Soviet space station Mir and directs NASA to request a study by the National Academy of Sciences on such cooperative activities.

PLANETARY EXPLORATION

Comet Rendezvous Asteroid Flyby (CRAF) Program.--The Committee is

concerned about the turbulence in the CRAF program over the past year.

Planetary Exploration and the Proposed Office of Exploration.--The Committee has reservations about the potential transfer of robotic missions from the OSSA to the new office of Exploration and urges the NASA Administrator to formally solicit the views of the scientific community prior to approving such a transfer.

EARTH SCIENCE AND APPLICATIONS

Earth Observing System.--In the absence of the report of the Earth Observing System (EOS) external engineering review and an affordable plan for this program, the Committee has reduced the rate of increase in funding for EOS.

EOS Data and Information System.--The Committee directs NASA to maintain the schedule for the EOSDIS procurement and continue rapid development of EOSDIS Version 0.

Landsat Data Purchase.--The Committee has made $5,000,000 available only for the purchase of Landsat data for the Global Change Research Program, with the intention that NASA and the private operator of Landsat reach a mutual agreement on an equitable and low-cost price for Landsat Thematic Mapper data. The Committee urges NASA to assist in preserving archived Landsat data and to incorporate new and archived data into the EOS Data and Information System.

Earth Probes.--The Committee has augmented the funding for Earth Probes to accelerate the development of the Tropical Rainfall Measurement Mission and to fly the Earth science attached payloads deleted from the space station.

MATERIALS PROCESSING IN SPACE

Reduction in Funding for Space Station Utilization.--The Committee believes that NASA should provide alternative flight opportunities for the physics and astronomy attached payloads that were deleted from the Space Station program.

COMMUNICATIONS

ACTS Experiments Program.--The Committee believes that NASA should maintain adequate funding for an industry experiments program using ACTS notwithstanding contemplated establishment of Centers for the Commercial Development of Space.

INFORMATION SYSTEMS

Preserving Existing Data and Handling New Data.--The Committee urges NASA to devote sufficient resources to preserving data collected over the past 30 years.

TECHNOLOGY UTILIZATION

Reduction in Rate of Funding Increase.--The Committee believes that the technology utilization program can be made more effective within a more modest budget envelope.

COMMERCIAL USE OF SPACE

Budgetary Growth Associated With Flight Programs.--The Committee reaffirms its support for programs to encourage private investment in space activities but believes that budget realities prevent the near doubling of the budget for Commercial Use of Space.

Industry Participation.--The Committee requests a report on plans to increase incentives for the Centers for the Commercial Development of Space (CCDS) to obtain industry cash support, such as a matching fund program, and plans for the periodic recompetition of CCDS contracts.

SPACE RESEARCH AND TECHNOLOGY

Research and Development Support for the Commercial Launch Vehicle Industry.--The Committee continues to urge NASA to take actions to develop and provide new technologies to the commercial launch vehicle industry.

Flight Telerobotic Servicer.--The Committee reduces the funding for the Flight Telerobotic Servicer program in the wake of the transfer of this program out of the Space Station Office.

EXPLORATION ACTIVITIES

SP-100 Reactor Program.--The Committee wishes to be kept informed as to how the exploration-related requirements of the SP-100 program are being addressed.

Synthesis Group.--The Committee notes that the Synthesis Group will be reporting on alternative approaches to human exploration. The Committee requests a report on NASA's response to the Synthesis Group's findings.

ACADEMIC PROGRAMS

Educational Goals of the Human Exploration Program.--The Committee commends the establishment of education as a primary goal of Human Exploration. The Committee believes that a focused program of secondary educational initiatives and direct university and academic programs will be necessary to provide the educated workforce necessary to carry out an aggressive Human Exploration program.

SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY

Orbiter Production Readiness.--The Committee directs NASA to move

with all deliberate speed to complete a long-range plan for the Space Shuttle Orbiter production line.

SPACE SHUTTLE OPERATIONS

Cost Savings in the Space Shuttle Program.--The Committee notes the testimony of key NASA officials that significant cost savings could be achieved in the Space Shuttle program without causing a negative impact on quality or safety. The Committee expresses support for such an initiative.

LAUNCH SERVICES

Deletion of Funding for the MSAT Launch Vehicle.--Given the recent court decision effectively rescinding the license for the American Mobile Satellite Consortium (AMSC), the Committee believes that funding to pay for part of the launch vehicle for AMSC's mobile communications satellite (MSAT) would be premature and that federal agencies should procure MSAT services directly as required.

SPACE AND GROUND NETWORKS, COMMUNICATIONS, AND DATA SYSTEMS

Adequacy of Funding.--The Committee expresses its concern that delaying planned improvements of aging and inefficient equipment may result in greater long-term costs and degradation in NASA's ability to support future flight missions.

Advanced Tracking and Data Relay Satellite.--The Committee views the Advanced TDRS procurement as an opportunity to establish a more cost-effective space network and urges NASA to consider procurement on a fixed-price basis as one potential option.

LEGISLATIVE REPORTING REQUIREMENTS

Reference and Requirement

Section 4--A report on the long range management plan for the Space Station program including the evolution of the systems engineering and integration and operations responsibilities. Due by December 31, 1991.

Section 4--A report on an independent engineering review of the Space Station restructuring by the Aeronautics and Space Engineering Board of the National Research Council. Due by January 31, 1992.

Section 4--A National Academy of Sciences study on the utilization of the Soviet space station Mir to support near-term United States life sciences research activity. Due within one year after the commencement of the study, which is to be initiated within sixty days of the enactment of this Act.

Section 4--A report on NASA's response to the Findings and Recommendations of the Synthesis Group. Due six months after the release of the Synthesis Group's report.

Section 4--A report on NASA's plans for increasing incentives for Centers for the Commercial Development of Space (CCDS) to obtain industry cash support, NASA's process for reviewing the level of industry support obtained by the centers, and NASA's plans for recompeting the CCDS contracts. Due on November 1, 1991.

Section 4--A report summarizing the progress NASA is making in providing technology support to the commercial launch vehicle industry. The report is due by March 1, 1992.

Section 4--A long-range plan for how to handle the production line for Space Shuttle Orbiters. This plan was originally due to the Committee by March 1, 1990. The committee directs NASA to "move with all deliberate speed" in completing this plan.

Section 4--A report on how NASA will achieve annual cost savings of 3 to 5 percent in the Space Shuttle program. The report is due by March 1. 1992.

45-073 O—91——29

EXPLANATION OF THE BILL AND COMMITTEE VIEWS

SECTION 1: SHORT TITLE

Section 1 designates that the act may be cited as the "National Aeronautics and Space Administration Multiyear Authorization Act of 1991."

SECTION 2: FINDINGS

Section 2(1) finds that the report of the Advisory Committee on the Future of the U.S. Space Program, known as the "Augustine report", has provided a framework for developing a consensus on space goals.

Section 2(2) finds that a balanced science program should be funded at 20 percent of the non-institutional budget of NASA. This is intended to maintain an overall balance between science and infrastructure development.

Section 2(3) finds that cooperation with the Soviets on the Space Station Mir may enhance the life sciences data base. This finding is based on the foreign policy benefits that may accrue and the overall cost effectiveness of utilizing existing space capabilities, especially in view of the diminishing scope of life sciences intended for the near term on the Space Station Freedom. This finding is not intended to signify any lessening of support for a strong U.S. program of permanent manned presence in space.

Section 2(4) finds that the space program can make substantial contributions to medical and health related research. The intent is to encourage an integrated plan of health research between NASA and other health related research agencies.

Section 2(5) finds that Landsat data are essential to any long term environmental research program such as Mission to Planet Earth. The Committee intends that NASA undertake efforts to integrate Landsat data into the EOS Data and Information System for use by participating researchers.

Section 2(6) finds that heretofore classified remote sensing data may be of use for environmental research programs such as Mission to Planet Earth and Global Change. The Committee intends that NASA undertake a program, in cooperation with Defense and Intelligence agencies, to study ways of utilizing such data without compromising national security.

Section 2(7) finds that the Space Exploration Initiative will depend directly on the generation of trained scientists and engineers. The Committee believes that the successful generation of the necessary trained work force can be accomplished through a balance of societal educational initiatives at the secondary educational level, and also through directly administering related grants and contracts to

colleges and universities to employ faculty and students in space exploration research.

Section 2(8) finds that policies which restrict the use of foreign launch vehicles for U.S. government satellites should only apply when adequate U.S. launch capabilities are available. The Committee recognizes that such restrictive policies are intended to provide support for a strong U.S. launch services industry. Indeed, the Committee has provided NASA ample authority in the past to restrict procurement of launch services to domestic sources. However for some satellites, such as the Earth Observing System platform A, the absence of a U.S. launch system with lift capabilities between the Atlas E and Titan IV-class vehicles from the West Coast has resulted in a program which may be overly complex and costly. The Committee strongly feels that adequate launch capabilities out of the West Coast should be established. However, if such is not possible, the intent of this finding is to encourage the seeking of waivers from any such restrictive policies if the application of such policies does not serve the public interest or result in a cost-effective scientific program.

Section 2(9) finds that NASA's aeronautical program contributes to the Nation's technological competitive advantage, and that the program has been a key factor in the U.S. in maintaining preeminence in aviation over the past decades.

Section 2(10) finds that the new and innovative technologies developed for the National Aero-Space Plane may benefit military and civilian aviation programs, particularly those involving high-speed aeronautical and space flight.

SECTION 3: POLICY

Section 3(1) states the policy that the Administrator should ensure resiliency in the space infrastructure. The Committee intends that this policy result in multiple capabilities for access to space, especially in assembling and servicing the Space Station.

Section 3(2) states the policy that a balanced and stable science program should be planned to minimize future year funding requirements.

Committee view

Science Budget "Bow wave"

The Committee clearly recognizes the great progress that has been made in developing an overall strategic plan for carrying out a balanced space science program. This plan has provided valuable long range planning data on the decisions that can be anticipated in initiating future missions and projects. The report of the Advisory Committee on the Future of the U.S. Space program has recommended the

execution of this strategic plan and, further, established a budgetary context for this plan as a 20 percent share of the overall NASA budget (normally taken to be the non-institutional budget, Research and Development, and Space Flight, Control, and Data Communications).

The Committee endorses these recommendations as a reasonable way of structuring a balanced science program that provides a steady stream of new starts. However, the Committee notes that the fiscal year 1992 request for NASA's overall science program represents an increase over FY 1991 of nearly 21 percent of which less than one percent is attributable to new starts. Furthermore, the funding required in fiscal year 1993 to carry out the programs approved in fiscal year 1992 represents an increase of 22 percent. Thus, the issue arises whether such increases can be expected in the present budgetary environment and, if not, can such a strategic plan be considered sound.

Figure 2 shows a general representation of the budgetary context implied by the Augustine report. Shown is a 20 percent allocation of the overall NASA budget for the past two fiscal years together with the next three fiscal years if the overall NASA budget grows in real terms by 10 percent per year. This can be compared to the budget actually provided in the past and requested in the future for NASA's science program exclusive of the Earth Observing System (EOS) (which is generally considered to be a "special initiative" and not included in a balanced science program). The additional funding for the Earth Observing System is also shown.

[figure 2]

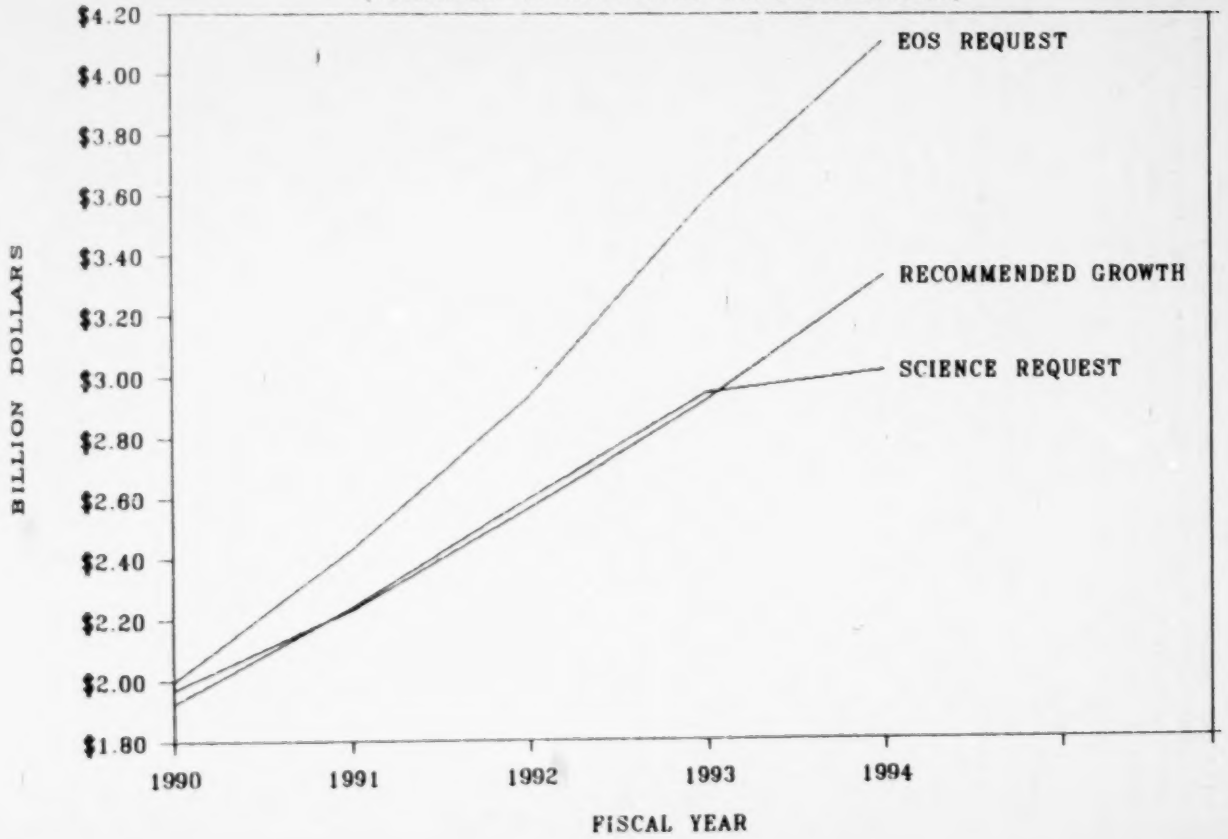
As shown, if the budget continues to grow at the optimistic rate recommended by the Augustine report, NASA's fiscal year 1993 budget for the balanced science program contains virtually no margin and no planned possibility for a new start. Not until fiscal year 1994 does any margin materialize. The Committee is concerned that any failure of the NASA budget to grow at the optimistic rate will result in program stretch outs (with their attendant cost overruns), program cancellations, a malaise in new activity, and a general disruption in the science community. Science opportunities that have been promised cannot be provided.

In addition, the funding required for the special initiative, EOS, must be provided from elsewhere in the budget. NASA's multiyear budget request shows that funding for Research and Program Management and Space Flight is expected to stabilize and conceivably provide this funding wedge. Indeed, the Augustine report recommends substantial initiatives to reduce personnel overhead, Center overlap, and greater efficiencies in the Shuttle program. The Committee notes, however, that stabilizing these programs will be a challenging management task and genuine cost savings must be realized if such special initiatives as EOS are to be carried out above and beyond the balanced science program.

The Committee recommends that NASA reevaluate its strategic science

FIGURE 2. SCIENCE BUDGET PROJECTIONS

(COMPARED TO AUGUSTINE RECOMMENDATIONS)



plan to establish a more realistic budgetary context. Announcements of opportunity must be carefully managed and offered only if genuine and realistic opportunities exist. Finally, NASA should plan such special initiatives as EOS only if legitimate funding wedges can be developed from efficiencies elsewhere in the NASA budget.

Section 3(3) states that any major new launch system should be based on actual program requirements or policies established by Congress. The Committee's hearings have not identified any specific programmatic need for the proposed New Launch System at this time except for assembly of the Space Station. Although the Committee concurs with and endorses the recommendations of the Augustine report related to the need for a new launch system, the Committee seeks to integrate this recommendation into NASA's overall program plan.

Section 3(4) states that in fulfilling the mission of NASA as articulated in the original Space Act, the Administrator should undertake a program of research and development to enhance the competitiveness and cost effectiveness of the commercial industry. The Committee has provided funding for a component technology program for this purpose.

Section 3(5) states that a major activity of NASA should be to conduct research on pressing environmental problems such as global warming, ozone depletion, acid rain, deforestation, and smog.

SECTION 4: AUTHORIZATION OF APPROPRIATIONS

SECTION 4(a)(1)(A) SPACE STATION FREEDOM

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$2,028,900,000
1993	$2,426,000,000
1994	$2,790,800,000

Committee Recommendation:

Fiscal Year:	
1992	$2,028,900,000

Committee authorization recommendation

Section 4(a)(1)(A) authorizes $1,900,000,000 for fiscal year 1992, of which $25,000,000 is to be used for the development of an Assured Crew Return Vehicle. An additional $128,900,000 is authorized upon the submission of a report to the Committee on an independent engineering review of the Space Station restructuring by the Aeronautics and Space Engineering Board of the National Research Council.

Program description

The Space Station program is directed toward the development of a permanently manned, 30-year research facility in low-Earth orbit. It is an International Space Station, being developed jointly by the United States, Canada, the European Space Agency, and Japan. The multi-Center program is managed by means of a Level II Space Station Program Office located in Reston, Virginia.

The Space Station program is in the process of being restructured to conform to Congressionally directed budgetary guidelines. In addition, the Space Station program management structure is being reviewed by senior NASA management.

Committee views

Space Station Program Restructuring

The Committee has been a strong and consistent supporter of the Space Station program. The Committee notes with some disappointment that over the last several years many of the original capabilities that NASA indicated would be provided for the Space Station have been deleted or deferred into the indefinite future as a result of budgetary, cost, and technical difficulties. However, the Committee believes that the original program objective of providing a robust permanent outpost in space and a utilitarian laboratory for scientific activities should remain the preeminent goal.

The Advisory Committee on the Future of the U.S. Space Program and a number of other advisory groups have stated that the primary need for the Space Station is to do life sciences experimentation and to support the development and verification of long duration space operating systems for human space flight. A permanently manned, rather than a man-tended Space Station, is required to carry out those activities. The Committee is concerned, however, that the current restructuring of the Space Station program seriously weakens the commitment to achieving a permanently manned capability.

The tentative date for achieving a permanently manned capability (PMC) has been slipped three years into the future relative to the schedule in place just 18 months ago. In addition, the levels of budgetary reserves contained in the restructured program, the apparent lack of a specific funding plan for an Assured Crew Return Vehicle (ACRV), and a continuing uncertainty over the likely costs that will be associated with the operation of the Space Station mean that there may not be sufficient resources allocated in the program to achieve PMC.

The low level of reserves to cover problems during the crucial development period FY 1991-95 means there is an uncomfortably high likelihood of further schedule slippage during that time. Such schedule slips would have a significant cost impact, given that the program will be expending funds at the rate of $200 million per month during that period.

The ACRV is critical to the achievement of a permanently manned capability, and the Committee supports its development. However, the ACRV is estimated to cost $1-2 billion to develop, and NASA had not incorporated it into the Space Station budgetary plan during the restructuring.

The Committee reiterates its long-standing concern over the potential operations costs of the Space Station. The NASA Authorization Act for FY 1988 requires that the annual budget submission after FY 1997 for the basic operation and enhancement of the Station and its associated ground systems not exceed 10 percent of the total NASA budget. Control of operations costs must be a high priority of the Space Station program. Holding operations costs down may require changes in NASA's traditional approaches to operations. Indeed, in the Committee Report accompanying the FY 1987 NASA Authorization Act, the Committee urged NASA

> **to consider innovative approaches to operations cost control including institutional measures which will decrease the number of ground personnel required to operate the Station, minimize the sustaining engineering manpower, and reduce the administrative overhead, all while maintaining an adequate margin of safety.**

Since the Space Station is envisioned to be a national (and international) research facility, NASA may wish to consider how other national research facilities are operated, such as the DOE laboratories, which are operated by private contractors. The Committee offers no specific recommendations to NASA at this time, but does emphasize that it will be paying close attention to NASA's approach to operations over the coming year.

The Committee continues to be concerned that the restructured Space Station design has not reduced transportation requirements for the assembly and outfitting of the Station. The number of Shuttle flights required to assemble and outfit the restructured Station to the point of PMC is approximately equal to the number required to assemble and outfit the previously baselined complete Phase 1 Station, even though the restructuring eliminated a set of solar arrays, two nodes, and other content that had been in the Phase 1 program.

The Committee again notes that many of the previously planned uses of the Space Station have been eliminated or deferred in recent years, and the Committee thus is troubled by the impact of the restructuring on the Space Station's remaining capabilities to support scientific research. The Committee urges NASA to address constructively the issues raised in the reports of the National Research Council and the NASA Advisory Council on the utilization of the Space Station for scientific experimentation.

The Committee notes with approval that the adoption of a pre-integrated truss should reduce assembly EVA and simplify the assembly task. In addition, the adoption of down-sized modules should, if they are designed and managed properly, allow greater ground-based outfitting and checkout of the modules prior to launch. The Committee commends the NASA and contractor personnel involved in the restructuring for their hard work and dedication to the task.

Program Management

Many internal and external advisory groups strongly recommended the establishment and support of an independent Space Station Level II program office. In fact, this Committee, in its 1986 report on its investigation of the Challenger accident, recommended that NASA should give special attention to moving the Shuttle program manager to NASA Headquarters

> to avoid the confusion and inter-center rivalry that result from having a large multi-center program managed out of one of the participating centers.

All of these recommendations led to the establishment of the current Level II Space Station office. Furthermore, the National Research Council's 1987 report to the White House on the Space Station program recommended that

> NASA management must emphasize that the Space Station Program Director [i.e., the head of the Level II office] is the principal line manager of the Space Station Program and is accountable for the successful development of the Space Station. He must be equipped with authority commensurate with this accountability.

and

> The Space Station Program Office [i.e., Level II] must be continually supported and reinforced by senior NASA management. There are likely to be tendencies for control of the Space Station Program to move away from the Program Office to the NASA Centers. Such diffusion of influence would be highly inappropriate for the Space Station Program.

On the other hand, the Augustine Committee report clearly recommended a revision of this approach and the focusing of program management closer to the participating NASA Centers. In addition, many have argued that the existence of an independent Washington based program office is duplicative and costly. The Committee is aware of the substantial difficulties NASA has had in attracting highly qualified personnel for the Level II office.

Furthermore, the Committee fully recognizes that different management structures may be required for each major phase of the Station program. This need must, however, be balanced against the potential costs and loss of control that may accompany disruptive management changes. The need to avoid disruptions would appear to be particularly important over at least the next year, given that, as a result of the restructuring, "delta PDRs" and a Man-Tended Phase Review will have to be conducted, Work Package responsibilities will have to adjusted, program documentation will have to be revised, and so forth. Indeed, this type of activity may well persist until the Critical Design Review.

Since previous management plans submitted to the Congress have not discussed a change in the management structure like that which appears to be contemplated, the Committee requests that NASA develop a comprehensive long range management plan for the Station including the evolution of systems engineering and integration and operations responsibilities. This plan should recommend clear program responsibilities for the remaining phases of the Station program. In addition, the report must identify the cost and schedule impacts of proposed changes to the current management approach. The Committee requests that this plan be submitted accompanying any proposed management change but not later than December 31, 1991.

Engineering Review of the Space Station Restructuring

The Committee believes that the Space Station restructuring will have a significant impact on the future course of the program. The restructuring was completed on an extremely tight schedule, and many aspects of the restructured program are not yet fully understood. The Committee directs NASA to request that the Aeronautics and Space Engineering Board of the National Research Council conduct the review. The review should be submitted to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Technology of the Senate by January 31, 1992. The review should address at least the following: (1) an evaluation of the overall development and operating costs of the restructured Station, as well as an examination of the adequacy of the reserves provided and identification of any unfunded requirements; (2) a review of the potential to evolve the Station beyond the man-tended configuration and beyond the permanently manned capability; (3) an assessment of the potential and options for performing life sciences on the Station prior to the year 2000; (4) an assessment of the transportation options for the Station assembly and resupply including the role of a heavy lift launch vehicle; (5) an assessment of the logistics and maintenance requirements for the restructured Station; (6) an assessment of the ability of the restructured design to support utilization activities.

SECTION 4(a)(1)(B) SPACE TRANSPORTATION CAPABILITY DEVELOPMENT

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year	
1992	$879,800,000
1993	$999,800,000
1994	$997,400,000

Committee Recommendation:

Fiscal Year:	
1992	$679,800,000
1993	$799,800,000
1994	$847,400,000

Committee authorization recommendation

Section 4(a)(1)(B) authorizes the appropriation of $679,800,000 in fiscal year 1992 for Space Transportation Capability Development activities. This represents a decrease of $200,000,000 below the President's request. This decrease reflects the combined effect of: a $20,000,000 decrease in funding for Upper Stages, deferring some funding for the purchase of a Centaur upper stage pending completion of negotiations with the Defense Department; a $10,000,000 decrease in funding for Spacelab activities, deferring some hardware replacements; a $15,000,000 decrease in the Engineering and Technical Base, reflecting a slower than planned rate of growth; a decrease of $15,000,000 in Payload Operations and Support Equipment, deferring some Space Station support; a $15,000,000 decrease in Advanced Programs, deferring increased emphasis on a personnel transportation system; and a $125,000,000 decrease in funding for the New Launch System, leaving $40,000,000 for continued development of the Space Transportation Main Engine and $10,000,000 for studies to define the roles, missions, and configuration of the New Launch System.

Section 4(a)(1)(B) also authorizes the appropriation of $799,800,000 in fiscal year 1993 and $847,400,000 in fiscal year 1994 for Space Transportation Capability Development activities. The authorization for fiscal year 1993 is based on an Administration estimate of $999,800,000 and a reduction of $200,000,000. The Committee intends this reduction to be taken in funding for the New Launch System, leaving a total of $75,000,000 to fund that program in fiscal year 1993.

The authorization for fiscal year 1994 is based on an Administration estimate of $997,400,000 and a reduction of $150,000,000. The Committee intends this reduction to be taken in funding for the New Launch System, leaving a total of $125,000,000 to fund that program in fiscal year 1994.

Program description

The principal areas of activity in Space Transportation Capability Development include the operation of Spacelab flight hardware with some continuing development activities; procurement of Upper Stages required to place satellites in high altitude orbits; the Engineering and Technical Base support at the manned space flight centers; Payload Operations and Support Equipment for accommodating NASA payloads that will fly on the Space Shuttle; Advanced Programs study and evaluation efforts; Advanced Transportation Technology efforts including the Administration's request

for the definition and preliminary development of a new launch vehicle capability and improved propulsion technology; and the design and development of the United States/Italian Tethered Satellite System.

SECTION 4(a)(1)(C) PHYSICS AND ASTRONOMY

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$1,140,600,000
1993	$1,321,400,000
1994	$1,308,500,000

Committee Recommendation:

Fiscal Year:	
1992	$1,096,600,000
1993	$1,241,400,000
1994	$1,248,500,000

Committee authorization recommendation

Section 4(a)(1)(C) authorizes $1,096,600,000 in fiscal year 1992, $1,241,400,000 in fiscal year 1993, and $1,248,500,000 in the fiscal year 1994 for Physics and Astronomy. Of this amount, $6,000,000 has been transferred from the Materials Processing in Space budget line to allow alternate development of experiments that were to be Space Station attached payloads. The reductions from the President's request and from the estimates for fiscal years 1993 and 1994 shall be taken from the Advanced X-Ray Astrophysics Facility (AXAF) account. The reductions slow the rate of increase in AXAF funding over the next three years to allow increased time for technical development work.

Program description

The objectives of the Physics and Astronomy program are to increase understanding of the origin and evolution of the universe, the fundamental laws of physics, and the formation of stars and planets. The objectives of the Physics and Astronomy program are accomplished by means of a mixture of large free-flying space missions, Explorer spacecraft, Shuttle/Spacelab flights, and suborbital missions.

The Physics and Astronomy program will continue development of the third of the Great Observatories, the Advanced X-Ray Astrophysics Facility (AXAF) in fiscal year 1992.

Work will also continue on the Global Geospace Science (GGS) mission. This mission supports an international cooperative activity, the Collaborative Solar Terrestrial Research (COSTR) project. Teams from the United States, the European Space Agency, and Japan are involved in COSTR.

The Explorer program will continue development activities on the X-ray Timing Explorer (XTE) in FY 1992. In addition, two new Explorers, the Advanced Composition Explorer (ACE) and the Far Ultraviolet Spectroscopic

Explorer (FUSE), will begin development in fiscal year 1992.

Committee views

Advanced X-Ray Astrophysics Facility (AXAF)

The Committee is concerned that the Advanced X-Ray Astrophysics Facility (AXAF) program has been encountering technical difficulties in the mirror metrology activities associated with the development of the mirrors for the observatory. At the same time, the Committee recognizes that the development of the mirrors is technically very challenging. NASA indicates that the difficulties are being resolved, and the Committee hopes that this will prove to be the case. However, earlier spacecraft programs have demonstrated the programmatic risks in attempting to move too rapidly in the face of technical problems. For that reason, and because the overall budget request for space science is not sustainable, the Committee reluctantly is slowing the rate of increase of AXAF funding.

Deletion of Space Station Attached Payloads

The Committee regrets that the attached physics and astronomy payloads have been deleted from the Space Station program as a part of the restructuring. The experiments that were to have been carried out by means of the attached payloads have been a part of the Office of Space Science and Applications Strategic Plan for a number of years. Indeed, investigator teams, including a number from universities, had already been formed to implement those peer-reviewed proposals that had been approved by NASA. If the Strategic Plan's approach to setting priorities in the space science program is to have meaning, then provision should be made to provide alternative access to space for those experiments that have been part of the Strategic Plan but which have lost their originally planned payload carrier. Thus, the Committee is transferring $6,000,000 from the Space Station utilization account of the Materials Processing in Space budget line to fund development of alternative means of conducting experiments that were to fly as attached payloads on the Space Station.

Astronomy and Astrophysics in the 1990s

The Committee notes with interest that the National Academy of Sciences (NAS) has completed a review of potential space-based and ground-based astronomical and astrophysical projects that could be undertaken in the 1990s. The NAS committee achieved a consensus on a number of recommendations to strengthen the field, both through a judicious selection of missions and through improvements to infrastructure. The Committee urges NASA to give serious consideration to the findings and recommendations of the NAS study when the Office of Space Science and Applications revises its Strategic Plan.

An important feature of the astronomy and astrophysics program of the 1990s is the provision of small payload opportunities, which NASA plans to provide through the Small Explorer (SMEX) program. The SMEX program is intended to offer low cost, flexible, and rapid access to space for small and innovative payloads. The Committee thus reacts with some concern to reports from the science community that the SMEX program as currently

structured may not achieve those goals. Specifically, it is important that the paperwork and procedures associated with the SMEX program be streamlined to the maximum extent possible. In addition, flexibility should be available to experimenters in the design of missions, and rigid standardization should not be forced on disparate missions. The Committee urges NASA to work with the science community to ensure that the SMEX program is responsive to the needs of the investigators.

SECTION 4(a)(1)(D) LIFE SCIENCES

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$183,900,000
1993	$284,000,000
1994	$326,100,000
Committee Recommendation:	
Fiscal Year:	
1992	$183,900,000
1993	$224,000,000
1994	$246,100,000

Committee authorization recommendation

Section 4(a)(1)(D) authorizes $183,900,000 in fiscal year 1992, $224,000,000 in fiscal year 1993, and $246,100,000 in fiscal year 1994 for Life Sciences. Of the amount authorized in fiscal year 1992, $2,000,000 is provided for cooperative life sciences research activities on the Soviet space station Mir. The reductions from the President's estimates for fiscal year 1993 and fiscal year 1994 shall be taken from the Lifesat account. The intent of the reductions is to slow the rate of increase in Lifesat funding.

Program description

The Life Sciences program is directed toward increased understanding of human responses and adaptability to the space environment. Such knowledge is essential to the success of the ambitious human activities contemplated under the Space Exploration Initiative. It also has the potential to contribute to our understanding of terrestrial diseases and medical problems. The Life Sciences program will also provide information important to the success of Space Shuttle and Space Station operations.

Several Shuttle Spacelab missions with significant levels of life science experimentation are planned for fiscal year 1992. Definition and development of an integrated Centrifuge facility for use on Space Station will continue in fiscal year 1992. Lifesat, a reusable reentry satellite for life sciences research, will be a new program initiative in fiscal year 1992. Its mission initially will focus on radiation research.

Committee views

Lifesat

The Committee has strongly supported the need for the capabilities afforded by Lifesat. In addition to fulfilling the focussed research needs in space radiation, the Committee intends that the Lifesat program will provide to the life sciences community a means for frequent, low cost flight opportunities. NASA will have to exercise strong program discipline to ensure that Lifesat's development and recurring costs are kept under control. The Committee stated in H.R. 5649, the National Aeronautics and Space Administration Multiyear Authorization Act of 1990, H. Rept. 101-763, that it intended to review NASA's performance in meeting this goal. The significant increase in Lifesat program cost estimates over the last year concerns the Committee. Therefore, the Committee is reducing its authorization for the Lifesat program in fiscal year 1993 and fiscal year 1994 below NASA's planned runout. The Committee reiterates that continued Lifesat program cost growth will not be supported, since uncontrolled cost growth in any one life sciences flight project can jeopardize the conduct of a balanced Life Sciences program.

Cooperative Research on Mir

NASA has cooperated with the Soviet life sciences research community for a number of years. The Committee supports the continuation of appropriate cooperative activities in the life sciences. To that end, the Committee is providing $2,000,000 of the fiscal year 1992 Life Sciences authorization for cooperative life sciences research activities on the Soviet space station Mir. The intent of the funding is not to support policy studies but rather to support cooperative utilization activities. As part of this activity, NASA is directed to initiate, within sixty days of enactment of this Act, a National Academy of Sciences study on the utilization of the Soviet space station Mir to support near-term United States life sciences research activity.

This study shall be completed and reported to Congress within one year after commencement of said study.

SECTION 4(a)(1)(E) PLANETARY EXPLORATION

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$627,300,000
1993	$635,300,000
1994	$643,500,000

Committee Recommendation:

Fiscal Year:	
1992	$299,300,000
1993	$251,900,000
1994	$263,400,000

Committee authorization recommendation

Section 4(a)(1)(E) authorizes $299,300,000 in fiscal year 1992, $251,900,000 in fiscal year 1993, and $263,400,000 in fiscal year 1994 for Planetary Exploration. The amounts authorized in Section 4(a)(1)(E)

exclude funding for the Comet Rendezvous Asteroid Flyby/Cassini (CRAF/Cassini) mission. A multiyear authorization for the CRAF/Cassini mission, not to exceed $1,600,000,000, was provided in Public Law 101-611 (Nov. 16, 1990).

Program description

The Planetary Exploration program focuses on the scientific exploration of the solar system, including the planets, their satellites, comets, asteroids, and the interplanetary medium.

In fiscal year 1992, the Mars Observer spacecraft will be launched on an expendable launch vehicle to Mars, where it will go into orbit about the planet. Its mission objectives are to map the global surface composition, atmospheric structure and circulation, topography, gravity, and magnetic fields of Mars.

Development activities will continue on the CRAF/Cassini mission. The CRAF/Cassini program was restructured in early 1991. CRAF's mission is to pass by an asteroid and rendezvous with a comet, making long-term measurements. Cassini is intended to undertake long-term observations of Saturn's atmosphere, rings, magnetic field, and moons. As part of the mission, a probe will be launched into the atmosphere of the moon Titan.

Committee views

Comet Rendezvous Asteroid Flyby (CRAF) Program

The Committee is troubled by the turbulence in the CRAF program over the past year. The Committee recognizes that the withdrawal of planned foreign participation from part of the spacecraft development effort had an adverse impact on the program plan. Nonetheless, it appears to the Committee that there was an underestimation of the technical risk associated with the program, especially with respect to the Penetrator, which has led to significant upward cost pressures. The subsequent elimination of the Penetrator has led to a marked decrease in the science content of the mission relative to the original plans. That such a dramatic descoping had to occur so soon after the completion of the Phase B activities that should have bounded the technical and cost risks of the program prior to the initiation of Phase C/D is disturbing. The Committee will be watching the progress of this program very carefully over the coming year.

Planetary Exploration and the Proposed Office of Exploration

The Advisory Committee on the Future of the U.S. Space Program suggested that NASA consider establishing an Associate Administrator for Exploration "with responsibility for both robotic and manned exploration of the Moon and Mars." The NASA Administrator has indicated that he will establish a new Office of Exploration. To date, no decision has been announced regarding the potential transfer of robotic mission responsibility from the Office of Space Sciences and Applications (OSSA) to the new Office of Exploration.

The Committee has reservations about the wisdom of such a transfer.

Robotic exploration of the Moon and Mars has long been an integral part of a balanced planetary science program and would likely remain so even in the absence of a human exploration program. There do not appear to be compelling reasons to eliminate OSSA's responsibility for such robotic missions, although there clearly should be close coordination with the Office of Exploration. The Committee would therefore encourage the NASA Administrator to formally solicit the views of the scientific community through the appropriate solar system exploration committees of the NASA Advisory Council and the National Academy of Sciences prior to any decision on where to assign the responsibility for lunar and Mars robotic missions.

SECTION 4(a)(1)(F) EARTH SCIENCE AND APPLICATIONS

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$775,600,000
1993	$1,108,000,000
1994	$1,562,500,000

Committee Recommendation:

Fiscal Year:	
1992	$725,600,000
1993	$830,000,000
1994	$950,500,000

Committee authorization recommendation

Section 4(a)(1)(F) authorizes the appropriation of $725,600,000 in fiscal year 1992 for Earth Science and Applications. This represents a reduction of $50,000,000 from the President's request, reflecting the combined effect of: a reduction of $75,000,000 in the Earth Observing System, including the EOS Data and Information System; the addition of $15,000,000 for Earth Probes; the addition of $4,000,000 for Mission Operations and Data Analysis to continue those data analysis activities deferred in fiscal year 1991 by the reprogramming of $4,000,000 for the Ocean Color Mission data purchase; the addition of $1,000,000 for converting data collected by classified remote sensing systems to civilian uses; and the addition of $5,000,000 only for the purchase of Landsat data for global change research. The Committee intends that NASA and the private operator of Landsat reach a mutual agreement on an equitable and low-cost price for Landsat Thematic Mapper data. Section 4(a)(1)(F) also authorizes the appropriation of $830,000,000 in fiscal year 1993 and $950,500,000 in fiscal year 1994, which represents ten percent real growth in the Earth Science and Applications budget.

Program description

The Earth Sciences program consists of the Earth Observing System (EOS), the Earth Probes, precursor missions, and Earth science. These programs constitute NASA's Mission to Planet Earth, which is the space-based data collection and analysis activity of the U.S. Global Change Research Program. NASA's programs are part of a larger international effort related to gaining a better understanding of the Earth's environment and global

change phenomena.

The Earth Observing System will be a long-term effort to obtain a fifteen-year data set on atmospheric, oceanic, and geological processes and interactions, with the objective of examining critical global change phenomena and studying the Earth as a complete system. The program envisions a series of EOS-A and EOS-B spacecraft in polar orbit, each with a suite of instruments to allow simultaneous measurement of rapidly changing phenomena and intercorrection of instrument measurements. The first large platform (EOS-A) is scheduled for launch in fiscal year 1999. The Administration is currently conducting an external engineering review of the EOS program.

A key element of the EOS program is the Earth Observing System Data and Information System (EOSDIS). One of its major functions is handling the distribution, storage, and archiving of the data obtained from the EOS spacecraft. EOSDIS will also incorporate data from instruments on other U.S. and foreign Earth observation spacecraft. An indispensable complement to the EOSDIS effort is support for scientific research and data analysis activities.

Another extremely important part of the Mission to Planet Earth is the Earth Probes program. Earth Probes instruments will be flown on small and medium-sized satellites to obtain high-priority data in the near term or data which cannot be obtained by the EOS spacecraft. Precursor missions, including TOPEX/Poseidon and the Upper Atmospheric Research Satellite, will be flown in the next several years to improve our understanding of terrestrial, atmospheric, and oceanic processes. Finally, data from operational satellites, including Landsat and the environmental satellites operated by the National Oceanic and Atmospheric Administration, are essential to the Global Change Research Program.

Committee views

Earth Observing System

The Committee strongly supports the Mission to Planet Earth program because of its potential to dramatically improve our understanding of the Earth's environment and global change phenomena, including the impact of human activities on the environment. The Committee remains very concerned that the Earth Observing System program is not sufficiently resilient with respect to future budget shortfalls. Future budget constraints may lead to smaller funding levels than required to keep the original program on schedule, especially in a program with such large future funding requirements. Already, a shortfall in the expected fiscal year 1992 budget request has forced deletion of one major instrument from the first EOS satellite, a delay in the launch of the first EOS satellite, and a delay in developing instruments for follow-on satellites. Cost overruns and technical difficulties in a program of this complexity may also cause delays and reductions in capability.

Much of the EOS program's lack of resilience can be attributed to the placement of all of the proposed instruments for EOS-A on one large platform. Not only does this lead to greater technical complexity, but all

instruments and spacecraft systems must be developed in parallel leading to highly interactive schedule and cost risks.

The Advisory Committee on the Future of the U.S. Space Program found that "a combination of different size spacecraft appears to be most appropriate to meet the needs of simultaneity, accuracy, continuity, and robustness." The Committee notes that while the large platform concept addresses scientific requirements for simultaneity, these requirements are not absolute and other objectives, including continuity, program resilience and early return of data, are equally important.

As a result of the Augustine Committee's recommendation, the Administration is conducting an external engineering review of the EOS program. The results of this review will be essential for determining the future structure of the Mission to Planet Earth program. The Committee encourages this review panel to carefully examine the structure and content of the entire EOS program, including the first EOS-A satellite, and take concrete steps to make the program more resilient. The Committee recommends that the review panel consider the advantages and disadvantages of flying the EOS-A group of instruments on three or more smaller satellites. The Committee believes that while such a configuration may not be technically optimal, it would constitute a more resilient approach. If future budgets fall short of expectations, parts of the program can proceed on schedule while less urgent parts are deferred. The Committee also urges the review panel to consider the role of Landsat in the Mission to Planet Earth effort.

In the absence of the report of this external engineering review panel and an affordable plan for the EOS program, the Committee is not confident that the proposed program can be successfully funded and implemented. The Committee has reduced the Earth Observing System program by $75,000,000 in fiscal year 1992, which represents approximately half of the requested increase. The Committee expects that this can be accomplished by reducing the reserves for the EOS instruments and deferring some activities, reducing or eliminating funds for EOS-B and EOS-A follow-on studies, and reducing the level of support for internal EOSDIS activities while maintaining the current schedule for the EOSDIS procurement and continuing to rapidly develop the EOSDIS Version 0. Alternatively, if the external engineering review so recommends, NASA could implement an option to fly the EOS-A instruments, or variants, on more than one smaller spacecraft.

The Committee has provided for ten percent real growth in the total budget for Earth Science and Applications in fiscal years 1993 and 1994, which reflects the Augustine Committee recommendation for ten percent real growth for NASA. The Committee would consider increasing the allocations for fiscal years 1993 and 1994 pending the submittal of the report of the external engineering review, as well as NASA's response, and the identification of an adequate budget "wedge" for the Earth Observing System.

The Committee notes the current lack of a U.S. launch vehicle capability with a payload capacity to polar orbits intermediate between that of the Atlas E and Titan IV launch vehicles. Establishing such a capability requires modifications and additions to the current facilities at

Vandenberg Air Force Base and modifications to existing launch vehicles. The Committee recommends that NASA work with the Department of Defense (DOD) to ensure that any facilities planned by the DOD will also be available for use by NASA and any launch vehicle modifications take into account NASA's potential needs. The Committee also believes that NASA should not be restricted from using foreign launch vehicles when a similar capability is not available in the United States if such policies prevent the establishment of a resilient and cost-effective scientific program.

EOS Data and Information System

The Committee recognizes that NASA has devoted considerable attention and resources to the EOS Data and Information System (EOSDIS). The Committee views the EOSDIS as the most challenging aspect of the Mission to Planet Earth program and the key to obtaining the maximum benefits from our investment in this program. The Committee recommends that NASA maintain the schedule for the EOSDIS procurement and continue rapid development of the EOSDIS Version 0.

The Committee further recommends that NASA plan to incorporate data from other U.S. and foreign environmental satellites, both current and planned, in the operational version of EOSDIS. Use of existing data sets from other environmental satellites in prototype versions of the EOSDIS does not satisfy the need to integrate data sets from all available sources and make them accessible on a long-term basis. The Committee believes that NASA needs to work more closely with the international community to assure compatibility between the EOSDIS and data obtained from foreign Earth observation spacecraft, and reduce unnecessary duplication between U.S. and foreign programs.

Landsat Data Purchase

The Committee notes the consensus of the scientific community, as reflected in a report last year by the National Academy of Sciences, that Landsat data are sufficiently important to global change research that they should be incorporated in the EOSDIS. The Landsat data archives constitutes a two-decade record of environmental changes. Furthermore, while data from the EOS will not be available until 1999 or later, Landsat data are available now. Even after EOS-A is launched, Landsat data will constitute a valuable complement to the data from the EOS instruments.

The Committee has made $5,000,000 available only for the purchase of Landsat data for the Global Change Research Program. The Committee intends that NASA and the private operator should reach a mutual agreement on an equitable and low-cost price for Landsat data for the Global Change Research Program.

The Committee believes that NASA and the private operator of Landsat should take full advantage of the flexibility provided by the Land Remote-Sensing Commercialization Act of 1984, Public Law 98-365, as amended, which allows the private operator of the Landsat system to provide data at reduced prices for any research and development programs if a complete disclosure of the results of the research and development is made publicly available and the data are not used for commercial purposes or in

substantial competition with data available directly from the Landsat operator. The Committee notes that two-year old Landsat Multi-Spectral Scanner data are now available at 25 percent of the nominal price, reflecting the approximate marginal cost of reproduction and distribution. The Committee expects that arrangements could be made to provide new and archived Thematic Mapper data in a like manner.

The Committee does not view this data purchase program as a long-term solution to the problem of Landsat data continuity. The Committee urges NASA to coordinate with the other agencies involved in the U.S. Global Change Research Program to make more permanent arrangements which assure the availability of Landsat data to the civilian community. The Committee recognizes that this is not an issue for NASA alone, but as the agency responsible for collecting environmental observations from space for the Global Change Research Program, NASA should take the lead within the Committee on Earth and Environmental Sciences and the National Space Council to ensure that Landsat data will be available to the global change research community. The Committee believes that taking advantage of existing capabilities such as Landsat will enhance the cost-effectiveness of the Mission to Planet Earth program and provide important data sooner. The Committee believes that the fact that Landsat has commercial as well as scientific capabilities should not deter this country from continuing a program whose dividends have been so great.

The Committee also notes with great concern the possibility that a significant fraction of Landsat imagery acquired since 1972 will be lost in coming years as storage media degrade or the original processing systems become inoperable. The Committee believes that the Landsat data archive represents the fruits of a $1.5 billion public investment in Landsat and contains incredibly valuable information on the environment. The Committee recognizes that NASA is not the agency responsible for the data archives, but urges NASA to work with other responsible agencies to ensure that this data archive is transferred to more permanent storage media and incorporated to the extent practicable into the EOS Data and Information System (EOSDIS). The Committee believes that the Land Remote Sensing Commercialization Act, as amended, provides a sufficient mechanism for providing archived Landsat data to the EOSDIS.

Earth Probes

The Committee strongly supports an aggressive Earth Probes program. The Earth Probes program, consisting of both small and medium-size spacecraft, will allow important global change phenomena to be observed and studied in the near term, including investigations which cannot be carried out by the Earth Observing System. The Committee believes that the Earth Probes program is as important to our understanding of global change phenomena as EOS. Budgetary problems which might occur in the EOS program should not be allowed to adversely impact the content or schedule of the Earth Probes program.

In order to conduct the Mission to Planet Earth as a continually evolving program, as recommended by the Augustine committee, the Committee urges NASA to maintain sufficient flexibility in its program and budget planning to respond quickly to new needs as they arise. The Committee

believes that the Earth Probes program can serve to shorten the time between the generation of new scientific and environmental monitoring objectives and the return of relevant data from space.

The Committee notes with concern that the requested funding for Tropical Rainfall Measurement Mission (TRMM) is lower in fiscal year 1992 than the funding provided in fiscal year 1991 and regrets the deletion of the Earth science attached payloads from the space station. Accordingly, the Committee has added $15,000,000 for Earth Probes to accelerate development of TRMM and to make alternative arrangements to fly the attached payloads deleted from the space station program.

SECTION 4(a)(1)(G) MATERIALS PROCESSING IN SPACE

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year 1992	$125,800,000
Fiscal Year 1993	$201,400,000
Fiscal Year 1994	$233,600,000

Committee Recommendation:

Fiscal Year:	
1992	$115,800,000
1993	$201,400,000
1994	$233,600,000

Committee authorization recommendation

Section 4(a)(1)(G) authorizes the appropriation of $115,800,000 in fiscal year 1992 for Materials Processing in Space. The Committee intends that the reduction of $10,000,000 from the President's request in fiscal year 1992 be applied to the Space Station Utilization budget line. The Committee adopted language which transfers $6,000,000 from the Space Station Utilization budget line in Materials Processing in Space to the Physics and Astronomy budget line for alternative flight provisions for the physics and astronomy attached payloads deleted from the space station. The remaining reduction of $4,000,000 in fiscal year 1992 reflects the effects of the restructured Space Station program and the need to transition the utilization activities to life science after Permanent Manned Capability. In such case, materials science facilities and equipment scheduled to be available only after the PMC milestone will need to be reassessed. Section 4(a)(1)(G) also provides $201,400,000 in fiscal year 1993 and $233,600,000 in fiscal year 1994, in accordance with the President's request.

Program description

The Materials Processing in Space program uses the microgravity environment to conduct research in fundamental science, materials science, and biotechnology. The program includes ground-based research, Spacelab and space shuttle payload development and operations, and space station utilization planning and payload development.

Committee views

Reduction in Funding for Space Station Utilization

The Committee believes that NASA should make other arrangements to fly the attached payloads deleted from the space station, which were supported in previous years by the Space Station Utilization budget line. Accordingly, the Committee has transferred $6,000,000 from the Space Station Utilization line in Materials Processing in Space to the Physics and Astronomy line. In addition, the Committee has made an additional general reduction to the Space Station Utilization line, reflecting the Committee's concern that the programs to develop large materials processing facilities for the space station are not under control and that materials processing facilities scheduled to be available after Permanent Manned Capability should be reassessed.

SECTION 4(a)(1)(H) COMMUNICATIONS

President's request for fiscal year 1992 budget and estimates for subsequent years:

Fiscal Year 1992	$39,400,000
Fiscal Year 1993	$34,700,000
Fiscal Year 1994	$31,000,000

Committee Recommendation:

Fiscal Year:	
1992	$39,400,000
1993	$34,700,000
1994	$31,100,000

Committee authorization recommendation

Section 4(a)(1)(H) authorizes the appropriation of $39,400,000 in fiscal year 1992, $34,700,000 in fiscal year 1993, and $31,100,000 in fiscal year 1994 for Communications, in accordance with the President's request.

Program description

The main activity in communications is the Advanced Communications Technology Satellite (ACTS) program, including development of terminals for use in the ACTS experiments program. The ACTS launch is scheduled for fiscal year 1993. Other components of the communications program include research and hardware development for advanced communications concepts, research and development for the search and rescue program, and radio science studies.

Committee Views

ACTS Experiments Program

The Committee strongly supports the transfer of the ACTS experiments program to the Office of Commercial Programs, which the Committee believes will place a greater emphasis on industry involvement. However, the Committee is concerned that the funding intended for an industry experiments program using ACTS may be excessively diluted by institutional expenditures and non-ACTS research activities of new Centers for the Commercial Development of Space (CCDS) if additional funds are not made

available. The Committee believes that funding intended for an industry experiments program using ACTS should be sustained at a level that will guarantee direct ACTS utilization by industry and that this should be over and above resources directed at the establishment of the CCDSs.

SECTION 4(a)(1)(I) INFORMATION SYSTEMS

President's request for fiscal year 1992:
  Fiscal Year 1992.....$42,000,000
Committee Recommendation:
  Fiscal Year:
    1992.....$42,000,000

Committee authorization recommendation

Section 4(a)(1)(I) authorizes the appropriation of $42,000,000 in fiscal year 1992 for Information Systems. NASA plans to eliminate this budget line beginning in fiscal year 1993 and distribute its activities to other functions within the Office of Space Science and Applications.

Program description

The objective of the information systems program is to provide advanced data systems required to support flight projects in the Office of Space Science and Applications. In addition, in fiscal year 1992 NASA plans to initiate an effort to revitalize current space science data holdings.

Committee views

Funding for Preserving Existing Data and Handling New Data

Major science missions during the 1990s will lead to an explosion in data received. NASA's data archiving and distribution system will be severely stressed. Advances in information and data management systems are required if NASA is to support the need of the scientific community to access this data. In addition, NASA's previous efforts to preserve existing data archives have been found to be inadequate.

The Committee is concerned that the elimination of this budget line in future years will result in a reduced emphasis on preserving existing space science data and developing systems to cope with the torrents of new scientific data expected in the 1990's. The Committee urges NASA to provide the information systems program with the resources needed to preserve the existing data collected over the last 30 years and deal with the anticipated influx of new space science data.

SECTION 4(a)(1)(J) TECHNOLOGY UTILIZATION

President's request for fiscal year 1992 and estimates for subsequent years:
  Fiscal Year:
    1992.....$32,000,000
    1993.....$31,700,000

1994.....$33,000,000
Committee Recommendation:
Fiscal Year:
1992.....$27,000,000
1993.....$29,700,000
1994.....$33,000,000

Committee authorization recommendation

Section 4(a)(1)(J) authorizes the appropriation of $27,000,000 in fiscal year 1992, $29,700,000 in fiscal year 1993, and $33,000,000 in fiscal year 1994 for Technology Utilization.

Program description

The objectives of NASA's technology utilization programs are (1) to accelerate the application of new technology by the private sector; (2) to encourage secondary uses of NASA technology in non-aerospace fields, in both the public and private sectors; and (3) to develop applications of NASA's aerospace technology to meet non-aerospace needs. A network of Industrial Applications Centers (IAC's) and technology utilization officers at NASA centers form the core of the agency's technology transfer efforts. An open competition is planned to replace the current network of IAC's with six new centers geographically distributed around the country.

Committee views

Reduction in Rate of Funding Increase

The Committee strongly supports efforts to make NASA's technology transfer program more effective but believes that this can be accomplished within a more modest budget envelope. The Committee does not believe that the requested growth of more than thirty percent in fiscal year 1992 can be accommodated, especially given the large overall budget growth requested by the Office of Commercial Programs. Accordingly, the Committee has applied a general reduction of $5,000,000 to Technology Utilization in fiscal year 1992. The Committee believes that all activities within this budget line should share in the general reduction.

SECTION 4(a)(1)(K) COMMERCIAL USE OF SPACE

President's request for fiscal year 1992 and estimates for subsequent years:
Fiscal Year:
1992.....$118,000,000
1993.....$144,200,000
1994.....$137,400,000
Committee Recommendation:
Fiscal Year:
1992.....$107,000,000
1993.....$138,200,000
1994.....$134,400,000

Committee authorization recommendation

Section 4(a)(1)(K) authorizes the appropriation of $107,000,000 in fiscal year 1992, $138,200,000 in fiscal year 1993, and $134,400,000 in fiscal year 1994 for Commercial Use of Space activities. The reduction from the President's request is without prejudice and shall be accommodated by means of a general reduction. The Committee takes this action reluctantly, but the rapid increase in funding required for the major flight programs envisioned must be fit into the overall funding allocation that is likely to be available for NASA.

Program description

The Commercial Use of Space program primarily supports a network of sixteen Centers for the Commercial Development of Space (CCDS). The CCDSs are located at state and private universities and research institutes. The purpose of the CCDS program is to encourage increased private sector investment in research geared toward examining potential commercial uses of space.

The scientific and engineering researchers at the CCDSs are supported by basic grants of approximately $1 million per center. In addition, NASA funds payload development, payload integration, shuttle integration, and transportation into space for CCDS experiments. NASA's support to the CCDSs totals over $100 million in the fiscal year 1992 budget request, nearly double the fiscal year 1991 budget. The remainder of this account supports commercial development studies, headquarters support contracts, and NASA field center collaborative work with industry.

Committee views

Budgetary Growth Associated with Flight Programs

The Committee is encouraged by NASA's ambitious plans for its Centers for the Commercial Development of Space (CCDS). The Committee nevertheless believes that the large bulge in the budget of the Office of Commercial Programs (OCP) over the next three fiscal years cannot be achieved in the current constrained budget climate. The Commercial Use of Space budget request for fiscal year 1992 is nearly twice the fiscal year 1991 budget. Most of this bulge is attributable to the simultaneous initiation of two space transportation projects, Spacehab and COMET, which are intended to provide flights for experiments developed by NASA's CCDSs. For this reason, the Committee has made a general reduction of $11,000,000 in fiscal year 1992. This authorization still provides a greater than 70 percent increase in funding in fiscal year 1992.

The Committee notes that the practice of "front loading" commercial service contracts in order to establish a basis for investor confidence presents Congress with an untenable situation. That is, such contracts must be funded or such companies will encounter severe financial disruption. In addition, Congress must provide an inordinate amount of funding initially compared to the services received. The Committee intends to review the possibility of providing NASA with termination liability authority to alleviate these problems.

Industrial Participation

The Committee is encouraged by the large number of industrial affiliates who have worked with or expressed interest in the research being done by the CCDSs. However, a smaller number of these firms have provided significant cash support to the CCDSs and industry cash support remains a small percentage of total cash and in-kind support to the CCDS program. The Committee believes that it is essential that all of the research performed at the CCDSs be driven by interest from industry and receive direct financial support from industry. The Committee believes that the best measure of industrial interest in a project is direct financial (cash) support. The accounting methods for estimating the dollar value of in-kind support such as personnel and equipment do not appear to be consistent across the CCDSs and may not accurately reflect the value industry would place on this support. If NASA plans to continue using in-kind contributions as a measure of industry support, it should develop uniform standards for determining the value to industry of such contributions.

The Committee recommends that NASA consider ways to provide each center with greater incentives for obtaining industry funding for projects they propose to undertake. A matching fund program, whereby NASA provides a lower level of basic grant funding than it currently provides but matches industry cash contributions on a one-for-one or two-for-one basis up to some limit, would be one option for accomplishing this objective. Another option would be to prioritize payloads for flight based not just on technical merit but also on the amount of cash support received from industry. Projects with greater levels of industry support and equal technical merit should fly before projects with lower levels of support. A third option would be to require new CCDSs to list in their proposals the financial support from industry they will obtain if they receive a specific level of NASA support. NASA could evaluate the proposals based on the level of industry support and the credibility of such estimates.

Furthermore, the Committee notes that three of the CCDSs have received extremely little or no cash from industry. NASA originally planned to support the centers for only the first five years, after which time the centers would either become self-sustaining or would be discontinued. The Committee recommends that NASA consider periodically recompeting the contracts for CCDS status. New groups of researchers and industry partners might be better able to take advantage of NASA's support. Since NASA is planning to issue a request for proposals for one or two new centers to concentrate on satellite communications research, the Committee recommends that NASA consider recompeting the contracts for the three CCDSs that have not attracted industry funding and maintain the total number of CCDS at sixteen. Maintaining a fixed number of CCDSs at this time is consistent with the inability to provide all of the large budget growth requested by the Office of Commercial Programs.

The Committee requests that NASA provide it with a report, by November 1, 1991, outlining NASA's plans for increasing the incentives for centers to obtain industry cash support, describing NASA's review process for evaluating the level of industry support obtained by the centers, and describing NASA's plans for periodically recompeting the CCDS contracts. The Committee also strongly suggests that NASA require each

CCDS to include in its annual report to NASA a detailed breakdown of cash and in-kind support received from industry.

SECTION 4(a)(1)(L) AERONAUTICAL RESEARCH AND TECHNOLOGY

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$591,200,000
1993	$670,500,000
1994	$716,000,000
Committee Recommendation:	
Fiscal Year:	
1992	$591,200,000
1993	$670,500,000
1994	$716,000,000

Committee authorization recommendation

Section 4(a)(1)(L) authorizes $591,200,000 for fiscal year 1992, $670,500,000 for fiscal year 1993, and $716,000,000 for fiscal year 1993 for the Aeronautical Research appropriations.

Program description

The goal of the NASA Aeronautical program is to conduct research and develop technology to strengthen U.S. leadership in civil and military aviation. This goal is supported by five comprehensive program objectives: (1) emphasize emerging technologies with potential for order-of-magnitude advances in capacity or performance which will enhance the U.S. defense and economic competitiveness; (2) maintain NASA's laboratory strength by repairing and modernizing critical aging national facilities, providing advance scientific computational capabilities and enhancing staff technical excellence; (3) ensure the timely transfer of research results to the U.S. aeronautics community through reports, conferences, workshops, and active participation of industry in cooperative research programs; (4) ensure the strong involvement of universities in NASA's program to broaden the nation's base of technical expertise; and (5) facility support to the Department of Defense (DOD), other government agencies, and the U.S. industry for major aeronautical programs.

Committee Views

The Committee has recommended in the past that NASA increase its cooperative efforts with FAA and is pleased to see this as a major effort in the FY 1992 budget proposal. The areas chosen for emphasis between NASA and FAA include severe weather, human factors and air worthiness, among other things. The Committee strongly supports this effort and urges NASA to increase long-term research efforts in aging aircraft research, nondestructive evaluation, fire safety and other areas that will prevent aviation accidents from occurring.

The advanced Composite Technology program continues to provide support for polymer matrix composite development and cost reduction based on

performance projections that continue to be unrealistic in relation to accomplishments. A balanced program is needed between polymer matrix composites and monolithic aluminum alloys in order to assure that backup materials are available if the polymer goals are not reached. Funding for advanced aluminum development for both wide-body transports and the High Speed Commercial Transport, therefore, needs to be emphasized. Structural material research for HSCT must be accelerated in order to meet the time frame for materials selections in 1995 to support certification early in the first decade of the next century.

SECTION 4(a)(1)(M) TRANSATMOSPHERIC RESEARCH AND TECHNOLOGY

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$ 72,000,000
1993	$120,000,000
1994	$145,000,000

Committee Recommendation:

Fiscal Year:	
1992	$ 72,000,000
1993	$120,000,000
1994	$145,000,000

Committee authorization recommendation

Section 4(a)(1)(M) authorizes $72,000,000 for fiscal year 1992, $120,000,000 for fiscal year 1993, and $145,000,000 for fiscal year 1994 for Transatmospheric Research and Technology.

Program description

The transatmospheric research and technology program is a portion of the joint NASA/Department of Defense (DOD) National Aero-Space Plane (NASP) program. The program objective is to develop and then demonstrate, in experimental flight vehicles, the technology required to permit the Nation to develop reusable, single-stage-to-orbit (SSTO) vehicles with air breathing primary propulsion and horizontal takeoff and landing.

Committee Views

The Committee finds that the Administration's expression of strong support for NASP is very welcome. Moreover, the OSTP, DOD, NASA, and the USAF testimony that the program is a top priority, has both civil and military applications, and should be funded through Phase 3, should assure Congress that it will move forward as scheduled. The Committee also expresses continued strong support for the NASP research program.

National Aero-Space Plane Program

The National Aero-Space Plane (NASP) program was originally established by President Reagan as a high national priority in the January 1986 State of the Union address. A joint program was immediately established between

the Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA) in July 1986.

The Program is divided into three phases. Phase 1 was the concept feasibility study (called Copper Canyon) which ran from 1982 to 1985 and was essentially a pre-NASP phase. The study results defined the technical concept for the NASP program to be developed on Phases 2 and 3. Both phases have been revised since the first joint agreement.

The goal of Phase 2, the Concept Validation program, is to prove the relevant technologies are sufficiently mature to support the development of an experimental vehicle, the X-30. At the completion of Phase 2 in 1993, the progress in technology development will be assessed to determine if it is feasible to continue to Phase 3 in which two prototype vehicles would be manufactured and flown with the first flight in 1997. This schedule calls for a single-stage-to-orbit in 1999. These X-30 vehicles will be experimental vehicles with no operational missions or requirements.

The technologies that must be developed for the X-30 to fly include:

(a) a propulsion system designed primarily as an air-breathing multi-cycle ram/scramjet capable of operating on hydrogen fuel to speeds of approximately Mach 25.

(b) advanced materials in the airframe, engine and other parts of the aircraft that can withstand the high temperatures generated up to Mach 25 and still be completed reusable;

(c) a completely integrated engine and airframe that can operate effectively under a wide variety of speeds, temperatures, altitudes and flight conditions; and

(d) supercomputer technology capable of analyzing the aerodynamics of the integrated X-30 system.

The Administration approved on January 12, 1990 a joint teaming arrangement with all the major contractors currently working on the project. This will avoid a "down select" at the conclusion of Phase 2 and will preserve access to the best expertise of all parties.

Propulsion. Currently, the best air-breathing aircraft operate at speeds well below Mach 4. (Mach 1 is equal to the speed of sound which is 760 m.p.h. at sea level.) One concern has been the adequacy of facilities to test the scramjet engines at speeds (Mach 4 to 25) for which the engines have not previously been tested. The team has successfully tested one-seventh to one-quarter scale engines to Mach 8. Full-scale engine components have been tested up to Mach 6 and performances equalled and exceeded original expectations.

Advanced materials. Some sections of the X-30 are projected to be exposed to temperatures of 5,000 degrees Fahrenheit or higher during flight. Existing aircraft materials cannot withstand such heat, so the NASP Program must develop new materials and active cooling techniques that have this capability and are reusable. Very good progress is being made by the NASP team which includes a unique management arrangement for a joint research effort by all the NASP contractors. In fact, for several materials, the normal fifteen-year cycle between laboratory experiment and structural fabrication was compressed to only four years.

Integration of engine and airframe. The effective performance of a scramjet will depend on the efficient flow of air into the engine, which in turn depends upon the shape of the airframe. The underside of the aircraft will be the air inlet to compress air for the engine as well as the engine's exhaust nozzle. Consequently, the engine must be completely integrated with the airframe. This may well be one of the most complex engineering integration problem ever undertaken. Nevertheless, the progress to date is very gratifying.

Supercomputer technology. Because of the advances in supercomputer technology, it is possible to analyze the integrated performance through computational fluid dynamics (CFD). As a result of the use of CFD, analysis of mixing, combination and engine performance is ahead of schedule. Results to date have indicated that propulsion systems for the X-30 are feasible up to the maximum speeds needed to low orbit entry. In turn, the X-30 experimental flight data are essential to validate the CFD calculations.

Congressional and other related activities. The Committee has supported the NASP Program, contained in the Administration's NASA budget request, every year since the creation of the program. The funding history is presented in Table 1.

TABLE 1. - NASP FUNDING
(in millions of dollars)

	Fiscal year--			
	1986-1989	1990	1991	1992
DOD	569	194	163	233
NASA	237	60	95	72
Total	806	254	258	305

The President's Science Advisor, Dr. Allan Bromley testified at the March 12, 1991 Joint Armed Services - Science Committee hearing. He said, "The National Aero-Space Plane is a sterling example of government-industry cooperation in advancing generic technologies that promise broad application in both the defense and the commercial realms. And, in my view, many of these technologies will be of key importance to our Nation's competitive standing."

Dr. Bromley went into more detail about the teaming arrangement. "The government-industry relationship is also unique in that government laboratories and research centers have responsibility for explicit pieces of work on the program's main development path. This is a significant departure from the customary generic R&D role of government researchers."

Regarding the expected 1993 decision to move to Stage 3, the actual construction of an aircraft, Dr. Bromley was very specific:

From everything I know of the program's maturity and

> progress, I would say that the national team should be in excellent shape to meet the Phase 2 exit criteria in FY 93. Once those criteria are met, I would be strongly in favor of moving forward to Phase 3. In my opinion, limiting our efforts to a generic hypersonic technology program after Phase 2 would not ensure that U.S. a technological lead. I also believe a generic technology program alone would not provide the foundation for an experimental flight vehicle program, because the highly qualified contractor team would be disbanded and integrated vehicle design activities -- the heart of hypersonic flight -- would cease.

J.R. Thompson, Deputy Administrator of NASA concluded at the March 12 joint hearing,

> NASA remains very strongly committed to NASP. The NASA Research Centers continue to be a vital part of the dynamic national team for NASP technology development. We are pleased to work with the Department of Defense and the National contractor team toward their next major program milestone: the 1993 decision on whether to build an fly the X-30. We believe that the NASP epitomizes the type of advanced technology programs NASA and the Nation should be doing; pushing technology well beyond its current limits to help ensure continued U.S. aerospace preeminence.

Also during the same hearing, Dr. Charles Herzfeld, Director of Defense Research and Engineering at DOD, stated, "I'm pleased to offer my views on the Administration's strong commitment to pursue the goals of the National Aero-Space Plane (NASP) program. It is an important program to the Department and the Nation."

Dr. Herzfeld listed three important reasons why DOD supported the NASP program.

> First, if the NASP program achieves its goals, the potential military benefits could be important. Vehicles derived from a successful NASP program could provide much needed rapid, cost-effective, flexible, and reliable access to space. They could also provide extended hypersonic atmospheric cruise capability for several candidate military missions. This is not only my personal view but the view of the Joint Chiefs of Staff the NASP program is strongly supported by the Strategic Air Command and the Air Force Space Command, again because of the potential military benefits that a successful NASP program would offer. Second, the current NASP technology development efforts will yield technology that is valuable in other areas of defense, including aircraft and missiles. The third reasons for continued DOD support is that the program is making good progress.

Dr. Herzfeld concluded with, "In summary, DOD remains strongly committed to the NASP program."

SECTION 4(a)(1)(N) SPACE RESEARCH AND TECHNOLOGY

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$354,800,000
1993	$321,700,000
1994	$317,200,000

Committee Recommendation:

Fiscal Year:	
1992	$324,800,000
1993	$351,700,000
1994	$367,200,000

Committee authorization recommendation

Section 4(a)(1)(N) authorizes $324,800,000 in fiscal year 1992 for Space Research and Technology activities. This represents a decrease of $30,000,000 below the President's request. This decrease reflects the combined effect of: an increase of $10,000,000 in the Research and Technology Base to initiate a research and development program focused on developing propulsion, guidance & control, vehicle, ground support, and other technologies that could benefit the commercial launch vehicle industry within the United States; and a decrease of $40,000,000 in Space Automation and Telerobotics reflecting the deletion of the $55,000,000 Flight Telerobotic Servicer project, and the reallocation of $15,000,000 to other automation and telerobotic activities.

Section 4(a)(1)(N) also authorizes the appropriation of $351,700,000 in fiscal year 1993, and $367,200,000 in fiscal year 1994 for Space Research and Technology activities. The authorization for fiscal year 1993 is based on an Administration estimate of $321,700,000, and the addition of $30,000,000 for the continued development of technologies in support of the commercial launch vehicle industry. The authorization for fiscal year 1994 is based on an Administration estimate of $317,200,000, and the addition of $50,000,000 for the continued development of technologies in support of the commercial launch vehicle industry.

Program description

The overall goal of the Space Research and Technology program is to ensure continued U.S. leadership in space by providing advanced, enabling technologies, validated at a level suitable for user-readiness, for future space missions. To achieve this goal, a broad base of advanced technology is required for vehicle and subsystem concepts, components, devices, and software. This is achieved by developing technical strengths in the engineering disciplines within NASA, industry, and academia and performing critical technology validations that facilitate the transfer of new technology with a high level of confidence to future space missions.

Committee view -

R&D Support for Commercial Launch Vehicle Industry

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The Committee continues to be concerned with the lack of progress over the past four years in establishing a focused program to develop and expand technologies that would be of value to the commercial launch vehicle industry within the United States.

The Committee has often noted the tremendous value that NASA's research and development initiatives have provided the commercial aircraft industry. These initiatives have been invaluable in helping to develop and maintain this key industry as the largest and most dynamic in the world. As such, this industry continues to provide the largest positive contribution to this country's balance of payments than any other industrial sector.

As in the past, the Committee continues to believe that the research and development support that NASA has long provided to the commercial aircraft industry in this country provides an excellent model for the type of support that NASA should provide to the commercial launch vehicle industry.

The commercial launch vehicle industry in this country finds itself at a distinct disadvantage when trying to compete in the world marketplace. In large part, this disadvantage has been due to the research and development and technical support that other countries have provided to their launch vehicle industries.

This Committee believes that NASA should take steps to assist the commercial launch vehicle industry in this country to become more competitive in the world marketplace. To assist in this effort, the Committee has provided funds that could be used to establish a focused program of developing the propulsion, guidance and control, vehicle, ground support and other technologies that could benefit the commercial launch vehicle industry in this country.

The Committee is aware of a study conducted by the Department of Transportation's Commercial Space Transportation Advisory Committee which recommends a similar component technology program. The Committee recommends that this be considered as a basis for the NASA effort. Further close cooperation between NASA and DOT on this issue would be highly beneficial.

Flight Telerobotic Servicer

The Flight Telerobotic Servicer (FTS) was a teleoperated robotic system that was being developed for use in the assembly and maintenance of Space Station Freedom. The critical design review (CDR) for the FTS demonstration test flight (DTF-1) was completed in the fall of 1990. However, the Space Station program office decided to delete the FTS development from the Space Station program. In the fiscal year 1992 budget request, NASA has transferred the FTS program to the Space Research and Technology budget line. It would account for the majority of the funding requested for space automation and robotics in fiscal year 1992. NASA has indicated that it will review the current FTS program plan to see whether it should be modified. The Committee believes that since the original mission of the FTS has been eliminated, the NASA telerobotics program should be structured in a way that maximizes the long-term technological gains to be realized from the program. In addition, the program should

contribute to the development of U.S. commercial capabilities in teleoperated robotic systems. Two other areas in which research and development activity could provide real benefits are in teleoperated Space Station or free-flyer payload technologies, and in the development of micro rover and other microtechnolgy applications for lunar and planetary exploration.

The Committee therefore reduces the funding requested for the FTS program by $40,000,000. The remaining balance of $15,000,000 is provided for research on telerobotics, teleoperated payload technologies, and for research on applications of microtechnology to robotic space exploration.

SECTION 4(a)(1)(O) EXPLORATION ACTIVITIES

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$ 67,000,000
1993	$ 88,000,000
1994	$102,400,000

Committee Recommendation:

Fiscal Year:	
1992	$ 61,000,000
1993	$ 88,000,000
1994	$102,400,000

Committee authorization recommendation

Section 4(a)(1)(O) authorizes $61,000,000 in fiscal year 1992. The reduction from the President's request for FY 1992 shall be accommodated by means of a general reduction of $6,000,000. Section 4(a)(1)(O) also authorizes $88,000,000 in fiscal year 1993, and $102,400,000 in fiscal year 1994 for Exploration Activities.

Program description

The Exploration Activities budget line funds Exploration Technology and Exploration Mission Studies. The Exploration Technology program is intended to develop advanced technologies that will support not only the Space Exploration Initiative (SEI), but will also be applicable to other areas of the nation's civil space effort.

Exploration mission studies are intended to develop the preliminary technical, scientific, and programmatic data needed to allow future decisions on the proper approach to human and robotic exploration of the Moon and Mars. In fiscal year 1992, the Exploration Mission Studies are to incorporate the findings of the Synthesis Group's studies into its analyses.

Committee views

SP-100 Reactor Program

The SP-100 program is a joint activity of NASA, the Department of

Defense, and the Department of Energy. The objective of the program is to develop a space nuclear power system. Since the program was initiated in the early 1980s, it has undergone several rephasings and the milestones have been delayed. The Committee is concerned that NASA's exploration requirements are not adequately addressed in the SP-100 program, especially since NASA's requirements include the capability to provide power on planetary surfaces under harsh conditions, whereas the Department of Defense requirements are focussed more on the development of an in-space system. The Committee would like to be kept informed about the status of the exploration-related aspects of the SP-100 program and how the exploration-related requirements for the program are being addressed.

Synthesis Group

The Synthesis Group has been examining alternative approaches to the conduct of the Space Exploration Initiative. The Synthesis Group is scheduled to report its findings in April 1991. The Committee is interested in how NASA will respond to the report of the Synthesis Group and how NASA proposes to incorporate the findings into its Exploration Technology and Mission Studies activities. The Committee directs NASA to provide a report to the Committee on its response to the findings and recommendations of the Synthesis Group, as well as its plans for incorporating those findings into its activities in fiscal year 1992. The Committee requests that the report be delivered to Congress within six months of the release of the Synthesis Group's report.

The Committee further directs the Administrator, in coordination with the Chairman of the Synthesis Group, to establish from among the membership of the Synthesis Group, a core group of advisors to assist in the assessment by NASA and other participating agencies of the recommendations contained in the official report of the Synthesis Group. Such advisory group shall be provided administrative support by NASA.

SECTION 4(a)(1)(P) SAFETY, RELIABILITY & QUALITY ASSURANCE

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$33,600,000
1993	$32,500,000
1994	$34,000,000

Committee Recommendation:

Fiscal Year:	
1992	$33,600,000
1993	$32,500,000
1994	$34,000,000

Committee authorization recommendation

Section 4(a)(1)(P) authorizes $33,600,000 in fiscal year 1992 for Safety, Reliability, and Quality Assurance activities. This authorization is equal to the President's request.

Section 4(a)(1)(P) also authorizes $32,500,000 in fiscal year 1993 and

$34,000,000 in fiscal year 1994 for Safety, Reliability, and Quality Assurance activities. These authorization levels are equal to the Administration's estimates.

Program description

The Safety, Reliability, and Quality Assurance program within NASA is intended to reduce the overall level of risk within the Agency's projects and activities. This is accomplished through such activities as the conduct of independent assessments, reviews, analyses, studies, and tests; the establishment of standards and guidelines; and the development of new inspection technologies, techniques, and devices.

SECTION 4(a)(1)(Q) ACADEMIC PROGRAMS

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$64,600,000
1993	$70,500,000
1994	$74,500,000
Committee Recommendation:	
Fiscal Year:	
1992	$64,600,000
1993	$70,500,000
1994	$74,500,000

Committee authorization recommendation

Section 4(a)(1)(Q) authorizes the amounts contained in the President's request for fiscal years 1992 through 1994.

Program description

NASA's Academic Programs conduct aerospace educational programs and activities to inspire and support, in elementary through graduate school, students to prepare themselves for careers in science, engineering and technology. Funding initiated in fiscal year 1992 will allow for the continuation of the current program including the continuation of the Graduate Student Researchers program at the Kennedy Space Center.

Committee views

Educational Goals of the Human Exploration Program

The Committee has considered NASA's contribution to the Nation's educational system one of the greatest benefits and highest priorities of the space program. The recent recognition of an overall decline in American educational standards compared to other industrialized nations makes this priority all the more important.

The Committee notes and commends the establishment of education as one of the long term goals of the Space Exploration Initiative. The Committee

further recognizes that present extrapolations of the science and engineering Phd work force necessary to carry out a robust Space Exploration Initiative falls short of what will be needed. Therefore, the Committee believes that NASA should undertake all practicable measures to assess and remedy this shortfall. These may entail a combination of societal educational programs aimed at secondary educational levels together with direct academic research programs which provide graduate and post graduate employment opportunities.

SECTION 4(a)(1)(R) TRACKING AND DATA ADVANCED SYSTEMS

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year 1992	$22,000,000
Fiscal Year 1993	$23,200,000
Fiscal Year 1994	$24,600,000

Committee Recommendation:

Fiscal Year:	
1992	$22,000,000
1993	$23,200,000
1994	$24,600,000

Committee authorization recommendation

Section 4(a)(1)(R) authorizes the appropriation of $22,000,000 in fiscal year 1992, $23,200,000 in fiscal year 1993, and $24,600,000 in fiscal year 1994 for Tracking and Data Advanced Systems.

Program description

The Tracking and Data Advanced Systems program provides for higher performance, higher reliability, and more cost-effective tracking and data handling capabilities for future space missions. This program is the research and development component of the Office of Space Operations, which runs the ground and space networks and the control and data acquisition facilities supporting all space flight missions.

SECTION 4(a)(2)(A) SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$1,288,900,000
1993	$1,277,000,000
1994	$1,210,500,000

Committee Recommendation:

Fiscal Year:	
1992	$1,358,900,000
1993	$1,277,000,000
1994	$1,210,500,000

Committee authorization recommendation

Section 4(a)(2)(A) authorizes $1,358,900,000 in fiscal year 1992 to support Shuttle Production and Operational Capability. This represents an increase of $70,000,000 above the President's request. This increase is the combined effect of: a $30,000,000 increase in Orbiter Operational Capability to provide additional support to maintain the readiness of the Orbiter production line and related production activities of Orbiter sub-contractors; a $50,000,000 increase in Propulsion Systems reflecting a transfer in this amount from the Construction of Facilities account to the Advanced Solid Rocket Motor program; and a $10,000,000 decrease in Assured Shuttle Availability deferring development of the Multifunction Electronic Display System. The Advanced Solid Rocket Motor program is authorized funding of $375,000,000.

Section 4(a)(2)(A) also authorizes $1,277,000,000 in fiscal year 1993 and $1,210,500,000 in fiscal year 1994 for Shuttle Production and Operational Capability. These authorization levels are equal to the Administration's estimates. However, the Committee questions the accuracy of these estimates given the lack of funding they provide for the Advanced Solid Rocket Motor program.

The Committee recognizes that the funds provided in fiscal year 1992 may not be sufficient to meet the needs of authorized Space Shuttle Production and Operational Capability programs. The Committee also recognizes that there may be additional funding flexibility within the Space Shuttle Operations account. Accordingly, the Committee would entertain a request to transfer funds from the Space Shuttle Operations account into the Space Shuttle Production and Operational Capability account.

Program description

The objectives of the Shuttle Production and Operational Capability program are to provide for necessary design modifications and safety improvements to support the Space Shuttle; needed capabilities at the launch site and for the flight operations process; continued development and testing of propulsion systems; and replacement of obsolete systems to ensure the long-term viability of the Shuttle program.

Committee **view**

Orbiter Production Readiness

In 1989, the Committee directed NASA to develop a long-range plan for handling the production line for Space Shuttle Orbiters. The Committee expressed increasing concern for the lack of such a policy and the resulting year-to-year nature of NASA's plans for this important production capability. NASA was directed to develop this long-range plan and submit it to the Congress by March 1, 1990.

The Committee finally received an "interim report" on NASA's efforts to produce such a plan on August 10, 1990. The Committee was informed that it would receive a completed detailed plan by October 1990. The Committee still has not received this completed plan.

The Committee is concerned that this continual lack of definitive action on the part of the Administrator may threaten the viability of the Orbiter production line through the loss of key prime contractor and sub-contractor capabilities.

The Committee has stated in the past that it could understand a decision by NASA to close down this production line if it were consciously made and well supported. On the other hand, simply permitting this production line and those of its sub-contractors to atrophy because of indecision and inaction is not in the public interest.

Accordingly, the Committee has taken action to preserve this production capability by once again authorizing an augmentation of funding support for structural spares and maintaining the readiness of the Orbiter production line and related production activities of Orbiter sub-contractors.

The Committee expects NASA to move with all deliberate speed in completing the Committee-directed long-range plan for the Space Shuttle production line. Until the completion and acceptance of this plan by the Congress, NASA should take whatever steps are required to preserve this production capability until a decision is reached regarding how it should be handled over the long term.

SECTION 4(a)(2)(B) SPACE SHUTTLE OPERATIONS

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$3,023,600,000
1993	$3,059,800,000
1994	$3,161,200,000

Committee Recommendation:

Fiscal Year:	
1992	$2,970,600,000
1993	$2,968,800,000
1994	$2,897,200,000

Committee authorization recommendation

Section 4(a)(2)(B) authorizes $2,970,600,000 in fiscal year 1992 for Space Shuttle Operations. This represents a decrease of $53,000,000 below the President's request. This decrease is a result of the combined effect of: a $14,000,000 reduction in operating costs due to the cancellation of the Flight Telerobotic Servicer Space Shuttle mission in 1994, cancellation of the Space Shuttle "Flight Opportunity" in 1995, and movement of the Aeroassist Flight Experiment Space Shuttle mission from 1995 to 1996; and a $39,000,000 reduction in operating costs due to anticipated efficiencies in the Space Shuttle program consistent with a goal of four percent savings per year in operating costs. The $39,000,000 reduction in operating costs is based on an assumed four percent savings minus the $85,000,000 savings reduction that has already been made by the Office of Management and Budget.

Section 4(a)(2)(B) also authorizes $2,968,800,000 in fiscal year 1993 and $2,897,200,000 in fiscal year 1994 for Space Shuttle Operations. The authorization for fiscal year 1993 is based on an Administration estimate of $3,059,800,000 and a reduction of $91,000,000. This reduction is the result the combined effect of: a $46,000,000 reduction in operating costs due to the cancellation of the Flight Telerobotic Servicer Space Shuttle mission in 1994, cancellation of the Space Shuttle "Flight Opportunity" in 1995, and movement of the Aeroassist Flight Experiment Space Shuttle mission from 1995 to 1996; and a $45,000,000 reduction in operating costs due to anticipated efficiencies in the Space Shuttle program consistent with a goal of four percent savings per year in operating costs. The $45,000,000 reduction in operating costs is based on an assumed eight percent savings minus the $217,000,000 savings reduction that has already been made by the Office of Management and Budget.

The authorization for fiscal year 1994 is based on an Administration estimate of $3,161,200,000 and a reduction of $264,000,000. This reduction is the result the combined effect of: a $73,000,000 reduction in operating costs due to the cancellation of the Flight Telerobotic Servicer Space Shuttle mission in 1994, cancellation of the Space Shuttle "Flight Opportunity" in 1995, and movement of the Aeroassist Flight Experiment Space Shuttle mission from 1995 to 1996; and a $191,000,000 reduction in operating costs due to anticipated efficiencies in the Space Shuttle program consistent with a goal of four percent savings per year in operating costs. The $191,000,000 reduction in operating costs is based on an assumed twelve percent savings minus the $214,000,000 savings reduction that has already been made by the Office of Management and Budget.

Program description

Space Shuttle Operations provides for Space Shuttle launch services for NASA payloads, and, on a reimbursable basis, for those of the Department of Defense, other civil agencies, and certain commercial and international users. Within this account, flight hardware is produced, refurbished, and repaired; and manpower, propellants, and other materials are furnished to conduct and support both flight and ground operations. Operations funding

also provides for the purchase of replacement spares for both flight and ground support hardware as existing inventories of spare parts are consumed as a result of flight-related activities.

Committee view

Cost Savings In the Space Shuttle Program

Two years ago, this Committee directed NASA to conduct a study to determine what efficiencies could be adopted within the Space Shuttle program to help offset the cost growth in excess of one billion that has occurred in the last several years. As stated in H.R. 1759,the National Aeronautics and Space Administration Multiyear Authorization Act of 1989, H. Rept. 101-226, the Committee encouraged NASA managers to be vigilant for changes in organization, procedures, operations, staffing, hardware design, etc. which could result in a reduction in the funds required to support the Space Shuttle program while causing no reduction in quality and safety.

The Committee report which NASA submitted in April 1990 in response to this requirement largely contained initiatives that have been in existence for a long time, some of which even predated the Challenger accident.

The Committee continues to believe that it should be possible to achieve savings in the Space Shuttle program without sacrificing quality and safety. This belief been reinforced by recent testimony to this Committee by key NASA officials.

For example, the Deputy Administrator testified on February 7, 1991 that it should be possible to reduce the annual cost of operating the Space Shuttle by 20 to 25 percent. Subsequently, on March 6, 1991, NASA's Associate Administrator for Space Flight testified that a 25 percent reduction in Space Shuttle operating costs could be taken as a goal and that he anticipated that a target for achieving that goal would be to achieve savings of three to five percent per year for about five years. He added that the savings would have to be achieved this way in order to maintain safety.

The Committee strongly supports this continued emphasis that NASA is placing on maintaining quality and safety within the Space Shuttle program. Additionally, the committee also supports whatever actions NASA can take to achieve cost savings within this program without jeopardizing quality and safety. In this regard, the committee believes that the Associate Administrator for Space Flight's anticipated target of achieving three to five percent savings for a period of five years is a reasonable goal.

The Committee directs NASA to report to the Congress by March 1, 1992 on exactly how it would begin to achieve this annual cost savings of three to five percent in the Space Shuttle program.

SECTION 4(a)(2)(C) LAUNCH SERVICES

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:
1992.....$341,900,000
1993.....$281,000,000
1994.....$315,800,000
Committee Recommendation:
Fiscal Year:
1992.....$305,900,000
1993.....$259,000,000
1994.....$309,800,000

Committee authorization recommendation

Section 4(a)(2)(C) authorizes $305,900,000 in fiscal year 1992 for Launch Services. This represents a $36,000,000 decrease below the President's request. This decrease is a result of the combined effect of: a $24,000,000 reduction reflecting the Committee's deletion of funding for the MSAT launch vehicle; and a $12,000,000 reduction reflecting savings that NASA will realize in purchasing a Titan IV launch in support of the CRAF/Cassini mission.

Section 4(a)(2)(C) also authorizes $259,000,000 in fiscal year 1993 and $309,800,000 in fiscal year 1994 for Launch Services. The authorization for fiscal year 1993 is based on an Administration estimate of $281,000,000 and a decrease of $22,000,000 reflecting the Committee's deletion of funding for the MSAT launch vehicle. The authorization for fiscal year 1994 is based on an Administration estimate of $315,800,000 and a decrease of $6,000,000 reflecting the Committee's deletion of funding for the MSAT launch vehicle. The Committee notes that it questions the accuracy of these estimates given the lack of funding they provide for the purchase of launch vehicles for TDRS-G, AXAF, CRAF, and Lifesats.

This category, formerly "Expendable Launch Vehicles and Services," has been renamed to reflect the fact that pursuant to the Launch Services Purchase Act of 1990 (Title II of Public Law 101-611) NASA will be relying entirely on outside providers for non-Space Shuttle launches, rather than purchasing additional launch vehicles for its own use.

Program description

Funding for Launch Services provides launch services for unmanned civil U.S. government space missions that do not require the Space Shuttle's unique capabilities. Consistent with the Commercial Space Launch Act, Public Law 98-575, as amended, expendable launch vehicle services are to be acquired from the U.S. private sector whenever possible.

Committee view

Deletion of Funding for the MSAT Launch Vehicle

The Committee has deleted the funding intended to pay part of the cost of a launch vehicle for the mobile communications satellite (MSAT) planned by the American Mobile Satellite Corporation (AMSC). The Committee notes that a recent U.S. Court of Appeals decision has effectively rescinded the license granted to this corporation by the Federal Communications

Commission (FCC). The court found that the FCC was acting at the periphery of its authority and did not demonstrate truly compelling reasons for forcing the applicants for a mobile satellite communications license into a single consortium.

Given this situation, it appears that the FCC will have to reconsider the license applications for mobile satellite service, a process which may take some time. As such, approval of this funding would be premature and the purpose for which this funding is intended may change significantly. Furthermore, the Committee believes that it would be preferable for federal agencies interested in obtaining mobile satellite services to purchase such services directly from AMSC or other providers as required, not through NASA or using funds from NASA's budget. The Committee does not believe that NASA should serve as a federal coordinator for operational services offered by commercial telecommunications firms.

SECTION 4(a)(2)(D) SPACE AND GROUND NETWORKS, COMMUNICATIONS, AND DATA SYSTEMS

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year 1992	$953,873,000
Fiscal Year 1993	$1,066,000,000
Fiscal Year 1994	$1,077,500,000

Committee Recommendation:

Fiscal Year:	
1992	$ 920,873,000
1993	$1,066,000,000
1994	$1,077,500,000

Committee authorization recommendation

Section 4(a)(2)(D) authorizes the appropriation of $920,873,000 in fiscal year 1992, $1,066,000,000 in fiscal year 1993, and $1,077,500,000 in fiscal year 1994 for Space and Ground Networks, Communications, and Data Systems. The $33,000,000 general reduction in fiscal year 1992 is without prejudice and may be absorbed by the elimination of the payment to the Federal Financing Bank for the Tracking and Data Relay Satellite System (TDRSS).

Program description

This program provides vital tracking, telemetry, command, data acquisition, communications, and data processing support to meet the requirements of all NASA flight projects. In addition, support is provided on a reimbursable basis for projects of the Department of Defense, other Government agencies, commercial firms, other countries, and international organizations.

Committee views

Adequacy of Funding

The Committee is concerned about this program's ability to adequately support the large number of missions scheduled for the 1990s given the requested budget levels. The delay in the launch of the Earth Observing System and the restructuring of the space station have led some requirements to slip. Nevertheless, the Committee believes that delaying planned improvements of aging and inefficient equipment may threaten NASA's ability to support future space flight missions in a cost-effective manner and result in greater long-term costs for developing and operating ground systems.

Advanced Tracking and Data Relay Satellite

The Committee notes that NASA has taken several positive steps in the fiscal year 1992 budget request. The cancellation of funding for the Tracking and Data Relay Satellite (TDRS) Flight 8 spacecraft and the shift of TDRS Flight 7 to an expendable launch vehicle, actions recommended by this Committee, are particularly noted. At the same time, the Committee notes with concern that the start of procurement for the Advanced Tracking and Data Relay (ATDRS) has been further delayed.

The Committee views the ATDRS series as an opportunity to establish a more efficient and cost-effective tracking and data relay network. The Committee believes that ATDRS should take advantage of advanced technologies where they promise better performance at lower cost, as long as the technical and programmatic risks are consistent with an operational project. The Committee also believes that the operational nature of the ATDRS series promises significant cost savings. The high reliability of commercial communications satellites procured under fixed-price contracts suggests that this approach might lower the Government's procurement costs. In particular, the Committee notes that the Navy is procuring its UHF Follow-On satellites under a commercial-like contract. The UHF Follow-On contractor will build the satellites under a fixed-price contract, procure launch services, and deliver the satellites to the Navy on-orbit.

The Committee recognizes that high technical risk or the need to make changes to the specifications or design during the development phase would make a cost-plus contract more appropriate. However, the Committee also recognizes that high technical risk and poorly defined performance specifications are incompatible with an operational program. The Committee believes that NASA should not be in the business of engineering operational communications satellites and should, to the extent practicable and reasonable, provide the potential contractors with performance specifications rather than detailed design specifications. Accordingly, the Committee urges NASA to carefully consider the potential advantages of procuring ATDRS under a fixed-price contract. As a minimum, the Committee believes that NASA should consider an arrangement whereby the first ATDRS satellite is procured on a cost-plus basis and additional models procured on a fixed-price basis. The Committee also intends that NASA take all possible steps to reduce the time currently planned for evaluating the ATDRS proposals and selecting a contractor. The time currently allotted to this activity appears to exceed what would be considered reasonable and customary for other procurements of operational spacecraft.

SECTION 4(A)(3) CONSTRUCTION OF FACILITIES

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$480,300,000
1993	$469,800,000
1994	$541,600,000
Committee Recommendation:	
Fiscal Year:	
1992	$430,300,000

Committee authorization recommendation

Section 4(a)(3) authorizes $430,300,000 for "Construction of Facilities." This authorization represents a $50,000,000 reduction in the Administration's request, reflecting a transfer in that amount from the Advanced Solid Rocket Motor project to the Space Shuttle Production and Operational Capability account. The Committee intends to continue to authorize institutional programs on an annual basis in order to more closely monitor specific expenditures and to ensure that these programs remain responsive to evolving agency needs.

The authorization bill drafted by NASA for fiscal year 1992 reduces the total of the amounts authorized for "Construction of Facilities" by $5,700,000 to $480,300,000 because of expected changes by the administration to the Davis-Bacon Act. NASA's action reflects the President's Budget statement for fiscal year 1992 that endorsed regulatory and legislative reform of the Davis-Bacon Act, including raising the threshold for contracts subject to the Act's provisions from $2,000 to $250,000.

The Davis-Bacon Act of 1931, Public Law 798, 71st. Cong., as amended, requires that construction contracts entered into by any agency of the Federal Government specify minimum wages to be paid to the various classes of laborers and mechanics employed under those contracts. The term "construction" includes direct construction, and the alteration or repair of public buildings and public works, including painting and decorating.

While the Davis-Bacon Act has enjoyed considerable support in Congress since its enactment, Congress has also devoted a significant amount of time to reviewing the Act in the past three decades. Changes to the Act during this time, however, have been minimal.

Accordingly, it is the Committee's intention that if the savings NASA expects from legislative and regulatory changes to the Davis-Bacon Act do not materialize, NASA shall absorb any shortfall from within amounts authorized under section 4(a)(3)(U) through (Y).

Program description

Section 4(a)(3) authorizes appropriations for contractual services for the repair, rehabilitation, and modification of existing facilities to maintain, upgrade, and improve the usefulness of the NASA physical plant; the construction of new facilities and the acquisition of related facility equipment needed to support science, space technology, and aeronautical

research; environmental compliance and restoration activities; the design of facilities projects; and advanced planning related to future facilities needs.

The projects and amounts in the budget estimates reflect requirements for Space Station Freedom and Space Flight facilities, including the Advanced Solid Rocket Motor Program, that are time-sensitive to meet certain specific program objectives. Other program requirements for fiscal year 1992 include modernization of the industrial area chilled water system rehabilitation, and expansion of the communications duct banks, and replacement of the 15 kilowatt load break switches at the Kennedy Space Center; repair of the site water system at the White Sands Test Facility; replacement of two central plant chillers and a boiler at the Johnson Space Center; completion of modifications to the X-Ray Calibration Facility in support of the advanced X-Ray Astrophysics Facility (AXAF) at the Marshall Space Flight Center; restoration and modernization of the high voltage distribution system and construction of a data information system facility in support of the Earth Observing System (EOS) program at the Goddard Space Flight Center; modernization of the main electrical substation at the Jet Propulsion Laboratory; continuation of restoration of utilities at the Wallops Flight Facility; projects to repair, restore, and modernize NASA's aeronautical research and development facilities at Ames, Lewis, and Langley Research Centers; and construction of a data interface facility and rehabilitation of the Tracking and Data Relay Satellite System (TDRSS) ground terminal at the White Sands Test Facility in New Mexico.

The fiscal year 1992 program continues to meet the objectives of preserving and enhancing the capabilities and usefulness of existing facilities and ensuring safe, economical, and efficient use of the NASA physical plant. This request continues the necessary rehabilitation and modification program begun in prior years and continues a responsive repair program. The repair program restores facilities to a condition substantially equivalent to their originally designed capability. The minor construction program continues to provide a means to accomplish smaller facility projects which accommodate changes in technical and institutional requirements. The environmental compliance and restoration program ensures that statutory environmental requirements are met and any necessary remedial actions are promptly taken.

Funds requested for facility planning and design cover advance planning for potential future projects, master planning, facilities studies, engineering reports and studies and the preparation of facility project design drawings and bid specifications.

SECTION 4(a)(4) RESEARCH AND PROGRAM MANAGEMENT

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$2,452,300,000
1993	$2,492,600,000
1994	$2,495,400,000

Committee Recommendation:

Fiscal Year:	
1992	$2,422,300,000

Committee authorization recommendation

Section 4(a)(4) authorizes $2,422,300,000 for fiscal year 1992. A reduction of $30,000,000 has been made without prejudice and may be absorbed by deferral of those costs associated with moving the NASA headquarters location. The Committee will continue to authorize Research and Program Management on an annual basis.

SECTION 4(a)(5) INSPECTOR GENERAL

President's request for fiscal year 1992 and estimates for subsequent years:

Fiscal Year:	
1992	$14,600,000
1993	$15,300,000
1994	$15,700,000

Committee Recommendation:

Fiscal Year:	
1992	$14,600,000
1993	$15,300,000
1994	$15,700,000

Committee authorization recommendation

Section 4(a)(5) authorizes funding in the full amount of the President's request for activities undertaken by the Inspector General in fiscal years 1992 through 1994.

SECTION 5--CONSTRUCTION OF FACILITIES REPROGRAMMING

Section 5 provides authority to transfer the amounts authorized for specific construction of facilities projects to meet unanticipated cost variations.

SECTION 6--SPECIAL REPROGRAMMING AUTHORITY FOR CONSTRUCTION OF FACILITIES

Section 6 provides authority to transfer funds appropriated for Research and Development, and Spaceflight Control and Data Communications to Construction of Facilities in order to account for new developments or scientific or engineering changes in the national aeronautical and space program.

SECTION 7--CONSIDERATION BY COMMITTEES

Section 7 requires the Administrator to give notice to the appropriate authorizing committees before using appropriations for any program not authorized or for an amount in excess of that authorized.

SECTION 8--SMALL BUSINESS INNOVATION RESEARCH PROGRAM

Section 8 authorizes the Administrator to utilize up to 5 percent of the funds provided for the Small Business Innovation Research Program for program management.

SECTION 9--OFFICE OF FACILITIES MAINTENANCE

Section 9 directs the Administration to create an Office of Facilities Maintenance at NASA that will have complete authority to plan and direct facilities maintenance management for all NASA sites.

Committee Views

The Committee has had a long standing interest in the maintenance of NASA's facilities. For example, the Committee vigorously supported NASA's Wind Tunnel Revitalization Program. The Committee often has expressed a need for NASA to properly maintain its facilities in order to meet program objectives. Moreover, when performed on a timely basis, a first class maintenance program can reduce the need for major repairs at a later date.

The Committee congratulates NASA for being forthright and sincere in its testimony before the Committee on March 5, 1991 when Samuel W. Keller, Associate Deputy Administrator, testified for NASA that:

> I certainly would agree that Admiral Truly's comments that the state of our maintenance at the present time is the result of a large number of independent decisions that have been made over the years. (Hearing before the U.S. House of Representatives, Committee on Science, Space, and Technology, March 5, 1991, Transcript at page 63 - 64.)

The Committee is disappointed, however, with NASA's defense of its present facilities maintenance management structure since that day. There has been no indication from NASA, that it intends to correct the basic problem of elevating the importance of facility maintenance within its management structure.

The Committee strongly believes that the authority and responsibility for facility maintenance should be centralized. Centralizing the authority and responsibility for facility maintenance should improve the condition of

NASA's facilities in a short period of time and should be less costly than is currently the case.

The Committee finds NASA's maintenance responsibilities are fragmented throughout five organizations at the Headquarters level: Research and Program Management, three major Program Offices, and Construction of Facilities. However, while NASA's Budget Summaries specify funding for maintenance under Research and Program Management and Construction of Facilities, the Budget Summaries do not specify funding for facility maintenance under the Research and Development Programs.

Furthermore, while there is a Director Of Institutions in at least one of the Program Offices, and while there is a competent Director for Facilities within that organization, the degree of authority of that Director is unclear since the authority for expending funds seems to by-pass that person and go directly through to the Center Director. The December 1990 General Accounting Office's "Report to the Chair, Subcommittee on VA, HUD and Independent Agencies, Committee on Appropriations, U.S. Senate, on NASA Maintenance: Stronger Commitment Needed to Curb Facility Deterioration" contained the following statement on page 21:

> NASA Headquarters has not provided comprehensive guidance to standardize the operation of the centers' maintenance management systems. Consequently, there is no standard maintenance system within NASA, and each center has developed its own approach to plan, budget, schedule, and report on maintenance requirements.

For example, in two of the NASA centers, there are three separate organizations all related to facilities. The Committee is of the opinion that organizational boundaries frequently lead to low morale and poor performance. Finally, at the Centers, institutional facility maintenance is included with security services, janitorial services and expenditures for utilities.

In the opinion of the Committee, the age of NASA's facilities require somewhat higher investments in maintenance than has been made in the past. However, the Committee cannot, in good conscience, recommend any increase unless and until NASA establishes one single office at the Headquarters level accountable for and with the authority to develop and direct an effective facility maintenance program throughout NASA. The Committee looks forward to the appointment of a qualified individual to direct this program early in FY 1992.

SECTION 10--COMMERCIAL SPACE LAUNCH ACT AMENDMENT

Section 10 authorizes the appropriation of $5,104,000 in fiscal year 1992 for the Office of Commercial Space Transportation. This amount is identical to the President's request for this office.

SECTION 11--NATIONAL SPACE COUNCIL AUTHORIZATION

Section 11(a) authorizes the appropriation of $1,491,000 in fiscal year 1992 to carry out the activities of the National Space Council established by section 501 of the NASA Authorization Act, Fiscal Year 1989 (42 U.S.C. 2471).

Section 11(b) expresses the sense of Congress that the National Space Council should develop policy recommendations for the follow-on program to Landsat 6.

SECTION 12--OFFICE OF SPACE COMMERCE AUTHORIZATION

Section 12 authorizes the appropriation of $491,000 in fiscal year 1992 for the Office of Space Commerce.

SECTION 13--AMENDMENT OF PUBLIC LAW 100-147

Section 13 requires NASA to annually provide in the Capital Development Plan estimated costs from the space station in then year and constant dollars for at least the first full year of steady operations. This action will aid the Congress in assessing NASA's ability to not exceed ten percent of its total budget for operating costs and in assessing the impact of design trade-off decisions.

SECTION 14--MUTLTIYEAR CONTRACTING

Section 14 requires the NASA Administrator to study the multiyear contracting authority used by the Department of Defense and the potential application of similar authority to NASA contracting. The Committee intends that candidate programs submitted with the study for consideration by Congress by substantive development programs of the agency.

SECTIONAL ANALYSIS

A bill to authorize appropriations to the National Aeronautics and Space Administration for Research and Development; Space Flight Control, and Data Communications; Construction of Facilities; Research and Program Management; the Inspector General; and for other purposes.

SECTION 1--SHORT TITLE

Section 1 designates that the act may be cited as the "National Aeronautics and Space Administration Multiyear Authorization Act of 1991".

SECTION 2--FINDINGS

Section 2 includes ten findings based upon hearings on the Advisory Committee on the future of the U.S. Space Program and authorization hearings.

SECTION 3--POLICY

Section 3 includes five policy statements intended to guide the formation of a balanced space program.

SECTION 4--AUTHORIZATION OF APPROPRIATIONS

Section 4 authorizes appropriations for fiscal years 1992, 1993, and 1994 for all NASA's research and operational programs.

SECTION 5--CONSTRUCTION OF FACILITIES REPROGRAMMING

Section 5 provides authority to transfer the amounts authorized for specific construction of facilities projects to meet unanticipated cost variations.

SECTION 6--SPECIAL REPROGRAMMING AUTHORITY FOR CONSTRUCTION OF FACILITIES

Section 6 provides authority to transfer funds appropriated for Research and Development, and Spaceflight Control and Data Communications to Construction of Facilities in order to account for new developments or scientific or engineering changes in the national aeronautical and space program.

SECTION 7--CONSIDERATION BY COMMITTEES

Section 7 requires the Administrator to give notice to the appropriate authorizing committees before using appropriations for any program not authorized or for an amount in excess of that authorized.

SECTION 8--SMALL BUSINESS INNOVATION RESEARCH PROGRAM

Section 8 authorizes the Administrator to utilize up to 5 percent of the funds provided for the Small Business Innovation Research Program for program management.

SECTION 9--OFFICE OF FACILITIES MAINTENANCE

Section 9 directs the Administration to create an Office of Facilities Maintenance at NASA that will have complete authority to plan and direct facilities maintenance management for all NASA sites.

SECTION 10--COMMERCIAL SPACE LAUNCH ACT AMENDMENT

Section 10 provides budget authority for the Office of Commercial Space Transportation.

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SECTION 14--MULTIYEAR CONTRACTING

Section 14 requires the NASA Administrator to study the multiyear contracting authority used by the Department of Defense and the potential application of similar authority to NASA contracting.

EFFECTS OF LEGISLATION ON INFLATION

In accordance with Rule XI, Clause 2(1)(4) of the Rule of the House of Representatives this legislation is assessed to have no adverse long-run inflationary effects on prices and cost in the operation of the national economy. NASA expenditures are labor intensive, with approximately 80 percent of spending directly for jobs and the remainder for materials. In fiscal year 1991, NASA will employ about 23,829 civil servants and support about 199,000 contractor and support services employees. Assuming a multiplier effect of 2.5, the total short-run employment effect on the United States' economy in fiscal year 1990 is about 557,000 jobs. In fiscal year 1992, NASA will employ 24,197 civil servants and support about 217,000 contractor and support services employees. Assuming a multiplier effect of 2.5, the total short-run employment effect on the United States economy in fiscal year 1991 is about 603,000 jobs. This represents less than one-half of one percent of the total civilian labor force in the United States--too

small to have a significant national effect. There could be some specific cases of industrial and regional employment and price changes influenced by NASA expenditures.

The most significant economic effects of NASA spending is the long-run productivity advance from new technologies developed for the space and aeronautics programs. Many NASA-sponsored advances in air and space transportation, communication satellites, remote sensing satellites, and other innovations have improved the productive capacity of industry and stimulated the development and growth of many new businesses.

NASA is actively pursuing its role to expand the opportunities for private industry to gain access into space effectively and economically use space for commercial ventures. These expanded business opportunities have stimulated and are expected to continue to stimulate more productive, non-inflationary private sector economic growth, job creation and improve the United States competitive economic position in the world, e.g., improve United States trade balance.

CHANGES IN EXISTING LAW MADE BY THE BILL AS REPORTED

In compliance with clause 3 of rule XIII of the Rules of the House of Representatives, changes in existing law made by the bill, as reported, are shown as follows (existing law proposed to be omitted is enclosed in black brackets, new matter is printed in italic, existing law in which no change is proposed is shown in roman):
[To be added later]

COMMITTEE OVERSIGHT FINDINGS AND RECOMMENDATIONS

Pursuant to rule XI, clause 2(1)(3) of the Rules of the House of Representatives, and under the authority of rule X, clause 2(b)(1) and clause 3(f), the Committee has incorporated in the present bill and report its findings and recommendations resulting from the Committee's oversight activities.

CONGRESSIONAL BUDGET OFFICE--COST ESTIMATE

SUMMARY OF FINDINGS AND RECOMMENDATIONS BY THE COMMITTEE ON GOVERNMENT OPERATIONS

COMMITTEE RECOMMENDATIONS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
BUDGET SUMMARY
In Millions of Dollars

	FY 1991	FY 1992 AUTHORIZATION		FY 1993 AUTHORIZATION		FY 1994 AUTHORIZATION		
	Approp	Pres Rqst	House Auth	Pres Est	House Auth	Pres Est	House Auth	Comments
RESEARCH AND DEVELOPMENT	6,023.6	7,198.5						
Space Station	1,900.0	2,028.9	2,028.9	2,426.0		2,790.8		$128.9 mil not avail till NRC study completed; $25 mil for ACRV
Space Transportation Capability Dev.								
Upper Stages	602.5	879.8	679.8	999.8	799.8	997.4	847.4	
Spacelab	82.2	108.5	(-20)					Defer Centaur funding pending DOD negotiation
Engineering & Technical Base	129.3	150.2	(-10)					Defer some hardware replacement
Payload Operations & Supp. Equip.	208.5	235.2	(-15)					Slow rate of growth
Tethered Satellite System	101.5	144.5	(-15)					Defer some Space Station support
Advanced Programs	21.9	12.6						
New Launch System	35.2	53.8	(-15)					
Space Science and Applications	23.9	175.0	(-125)					Defer increased emphasis on personnel transportation system
Physics and Astronomy	2,429.6	2,934.6			(-200)		(-150)	for FY92: $40 million for STME, $10 million for studies
Gamma Ray Observatory Dev.	975.1	1,140.6	1,096.6	1,321.4	1,241.4	1,308.5	1,248.5	
Advanced X-Ray Astrophysics Fac.	22.0	0.0						
Global Geospace Science	101.2	211.0	(-50)		(-80)		(-60)	Slow rate of growth for S/C & Mirror funding
Shuttle/Spacelab Payload Mission Mgmt	96.6	65.3						
Space Station Utilization	68.8	88.0						
Payload & Instrument Dev.	3.0	0.0						
Explorer Development	94.6	115.9	(+6)					
Mission Operation & Data Analysis	99.8	107.9						Develop fit opportunities for deleted Station attached payloads
Research & Analysis	313.5	388.4						
Suborbital Program	100.8	103.1						
Life Sciences	55.0	61.0						
Human Space Flight & System Eng.	138.0	183.9	183.9	284.0	224.0	326.1	246.1	
Research & Analysis	81.1	89.7						
Lifesat	56.9	79.2						$2 million earmarked for coop activities on Mir
Planetary Exploration	(2.0)	15.0			(-60)		(-80)	
Ulysses Development	457.1	627.3	299.3	635.3	251.9	643.5	263.4	Reduce growth rate in out-years
Mars Observer	3.0	0.0						
Mars Balloon Relay Experiment	78.5	54.4						
CRAF/Cassini	1.5	1.2						
Mission Operations & Data Analysis	145.0	328.0	(328.0)		(363.4)		(380.1)	CRAF/Cassini previously authorized in P.L. 101-611
Research & Analysis	161.2	150.5						
Space Applications	67.9	93.2						
Earth Science & Applications	859.4	982.8						
Earth Observing System	667.9	775.6	725.6	1,108.0	830.0	1,562.5	950.5	
Earth Probes	191.0	336.0	(-75)		(-278)		(-612)	Defer some increase pending technical review
Remotely Piloted Aircraft	54.7	68.2	(+15)					Increase emphasis on this program
Upper Atmosphere Research Satellite	0.0	5.0						
Ocean Topography Experiment	64.0	18.2						
Payload & Instrument Development	76.0	51.9						
Missions Operations & Data Analysis	49.7	48.6						
	39.4	56.3	(+5)					
Research & Analysis	193.1	191.4	(+5)					$6 million for activity deferred from '91; $1 million to convert classified remote sensing data
Materials Processing	102.3	125.8	115.8	201.4	201.4	233.6	233.6	$5 million for purchase of Landsat data
			(-10)					Transfer $6 million to Physics/Astronomy Payload & Instrument Development; $4 million general reduction
Communications	52.5	39.4	39.4	34.7	34.7	31.1	31.1	
Information Systems	36.7	42.0	42.0	0.0	0.0	0.0	0.0	Out year activities absorbed by other accounts

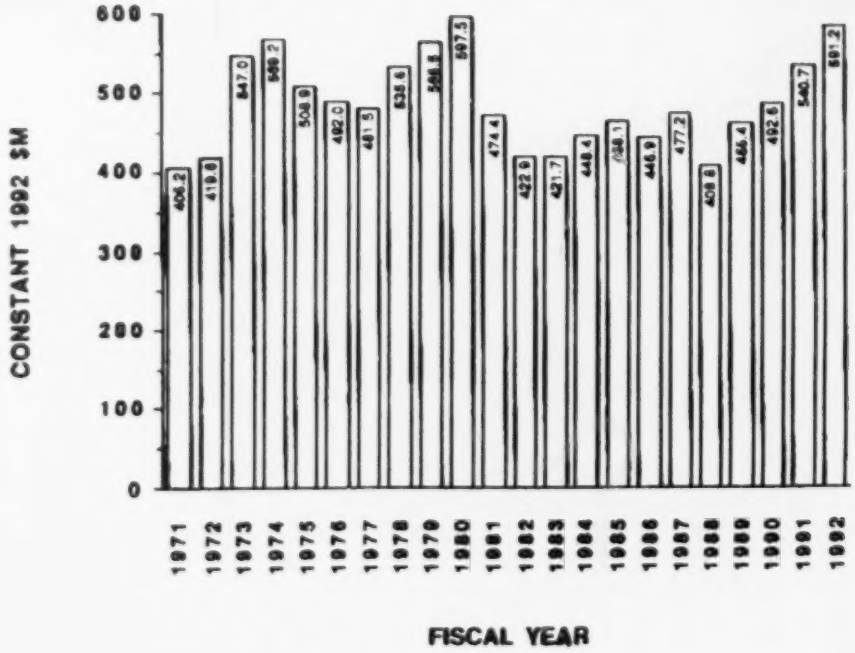
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
BUDGET SUMMARY
In Millions of Dollars

	FY 1991	FY 1992 AUTHORIZATION		FY 1993 AUTHORIZATION		FY 1994 AUTHORIZATION		
	Approp	Pres Rqst	House Auth	Pres Est	House Auth	Pres Est	House Auth	Comments
Commercial Programs	86.0	150.0						
Technology Utilization	24.6	32.0	27.0 (-5)	31.7	29.7 (-2)	33.0	33.0	General reduction to reduce rate of growth
Commercial Use of Space	61.6	118.0	107.0 (-11)	144.2	138.2 (-6)	137.4	134.6 (-3)	General reduction to reduce rate of growth
Aeronautical Research and Technology	512.0	591.2	591.2	670.5	670.5	716.0	716.0	
Transatmospheric Res. & Tech. (NASP)	95.0	72.0	72.0	120.0	120.0	145.0	145.0	
Space Research & Technology	(255.9)	(354.8)	324.8	321.7	351.7	317.2	367.2	
Research & Technology Base	125.7	141.6	(+10)		(+30)		(+50)	Establish commercial ELV R&D initiative
In-Space Flight Experiments	11.2	16.0						
Civil Space Technology Initiative	119.0	114.3						
Space Automation & Telerobotics	(22.2)	82.9	(-40)					Delete FTS & restructure A&T program
Exploration Activities	(34.5)	(67.0)	61.0 (-6)	88.0	88.0	102.4	102.4	General reduction
Exploration Technology	27.5	52.0						
Exploration Mission Studies	7.0	15.0						
Safety, Reliability & Qual. Assurance	33.0	33.6	33.6	32.5	32.5	34.0	34.0	
Academic Programs	55.1	64.6	64.6	70.5	70.5	74.5	74.5	
Tracking & Data Advanced Systems	20.0	22.0	22.0	23.2	23.2	24.6	24.6	
SPACE FLIGHT, CONTROL & DATA COM.	5,126.6	5,608.3						
Shuttle Production & Ops. Cap.	1,276.4	1,288.9	1,358.9	1,277.0	1,277.0	1,210.5	1,210.5	
Orbiter Operational Capability	275.6	273.8	(+30)					Additional support for Orbiter production line
Propulsion Systems	747.8	622.7	(+50)					Xfer from CofF; ASRM authorized at $375 million for '92
Launch & Mission Support	253.0	270.1						
Assured Shuttle Availability	0.0	122.3	(-10)					Defer Multifunction Electronic Display System
Space Shuttle Operations	2,790.0	3,023.6	2,970.6	3,059.8	2,968.8	3,161.2	2,897.2	Delete FTS flt in 94, Flt Oppty & AFE flt in 95; Anticipate
			(14;-39)		(-46;-45)		(-73;-191)	Shuttle efficiency of 4% per year
Flight Operations	801.5	912.5						
Flight Hardware	1,393.3	1,417.0						
Launch and Landing Operations	595.2	694.1						
Launch Services	229.2	341.9	305.9 (-36)	281.0	259.0 (-22)	315.8	309.8 (-6)	Delete NSAT funding; $12 savings in FY92 on a Titan IV
Space & Ground Networks, Com.	828.8	953.9	920.9 (-33)	1,066.0	1,066.0	1,077.5	1,077.5	General reduction
Space Network	310.1	348.0						
Ground Network	260.7	291.7						
Communications & Data Systems	258.0	314.2						
CONSTRUCTION OF FACILITIES	497.9	480.3	430.3 (-50)	469.8		541.6		Xfer ASRM equipment to ASRM R&D account
RESEARCH AND PROGRAM MANAGEMENT	2,211.9	2,452.3	2,422.3 (-30)	2,492.6		2,495.4		General reduction
INSPECTOR GENERAL	10.5	14.6	14.6	15.3	15.3	15.7	15.7	
TOTAL	13,868.3	15,754.0	*****	17,174.4	*****	18,295.3	*****	
			16,958.0		10,693.6		10,962.4	

	1990	1991		1992	Chairman's Recommendations 1992	1993	1994
	Actual	Original Estimate	Current Estimate	Budget Estimate			
	(thousands of dollars)						
AERONAUTICAL							
RESEARCH AND TECHNOLOGY BASE							
1. Research and Technology							
Aerodynamics R&T	104,400	120,400	116,500	128,300	128,300	142,500	144,100
Propulsion and Power R&T	67,900	75,700	71,700	84,100	84,100	88,300	92,000
Materials and Structures R&T	40,100	41,400	37,260	42,800	42,800	45,400	47,200
Controls, Guidancem and Human Factors R&T	63,200	65,000	60,300	67,600	67,600	71,500	74,400
Flight Systems R&T	38,300	40,600	40 400	42,100	42,100	44,600	46,300
Systems Ana;ysis	7,900	10,300	10,300	10,700	10,700	11,200	11,700
1A Total	321,800	353,400	336,400	375,600	375,600	403,500	415,700
SYSTEMS TECHNOLOGY PROGRAMS							
High perfomance Computing	Ref 2,000		17,000	17,000	17,000	49,000	73,000
Materials and Structures	28,100	39,900	39,900	40,100	40,100	35,500	36,300
Systems Technology Rotorcraft Systems Tech	3,600	5,100	5,100	5,200	5,200	5,400	5,500
High Performabce Aircraft Systems Tech	9,700	10,500	10,500	11,100	11,100	11,900	12,200
Advanced Propulsion Systems Tech	13,100	15,000	15,000	15,400	15,400	16,000	16,400
Numerical Aerodynamic Simulation	41,800	44,100	44,100	45,400	45,400	47,000	48,100
High Speed Research	24,500	44,000	44,000	76,400	76,400	89,900	90,400
Advanced Subsonic Tech				5,000	5,000	12,300	18,400
1b Total	120,800	158,600	175,600	215,600	215,600	267,000	300,300
1c TOTAL	442,600	512,000	512,000	591,200	591,200	670,500	716,000
2. Research & Program Mgt., Aeronautics portion (p _)	333,400	367,000	360,900	386,300	386,300		
3. Construction of Facilities, Aeronautical Facilities (p _)	61,200	56,000	46,000	51,600	51,630		
TOTAL	837,200	935,000	918,600	1,029,100	1,029,100		

	1990	1991		1992	Chairman's Recommendations		
	Actual	Original Estimate	Current Estimate	Budget Estimate	1992	1993	1994
TRANSATMOSPHERIC							
1 Research and Technology	59,000	127,000	95,000	72,000	72,000	120,000	145,000
2 Research & Program Mgm Transatmospheric portion	18,400	21,800	21,000	21,000	21,000		
TOTAL	77,400	148,800	116,000	93,000	93,000		

AERONAUTICS R&D FUNDING TREND



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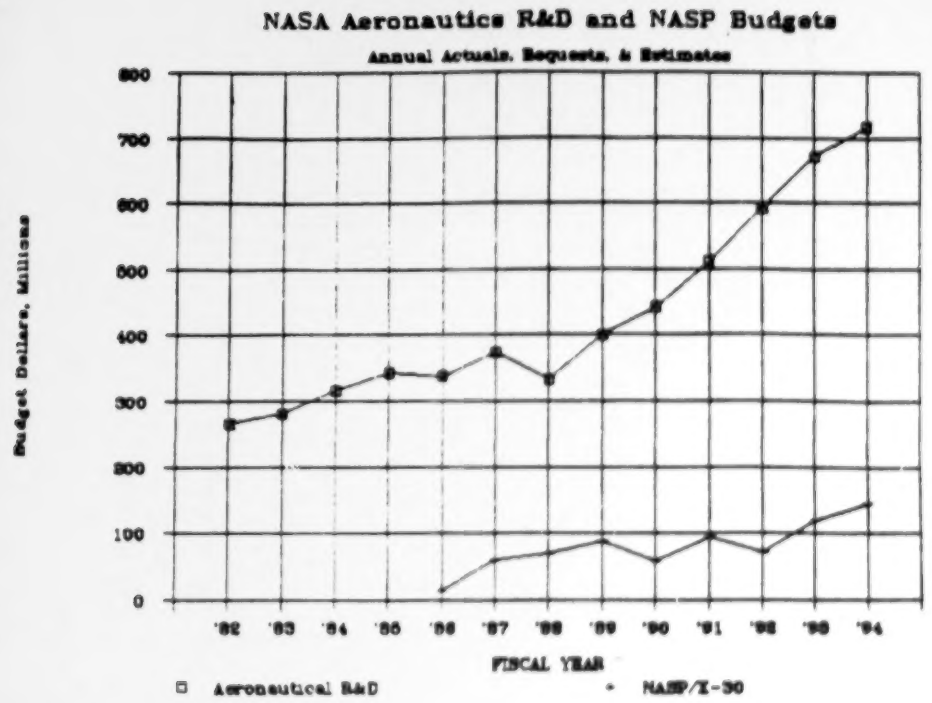
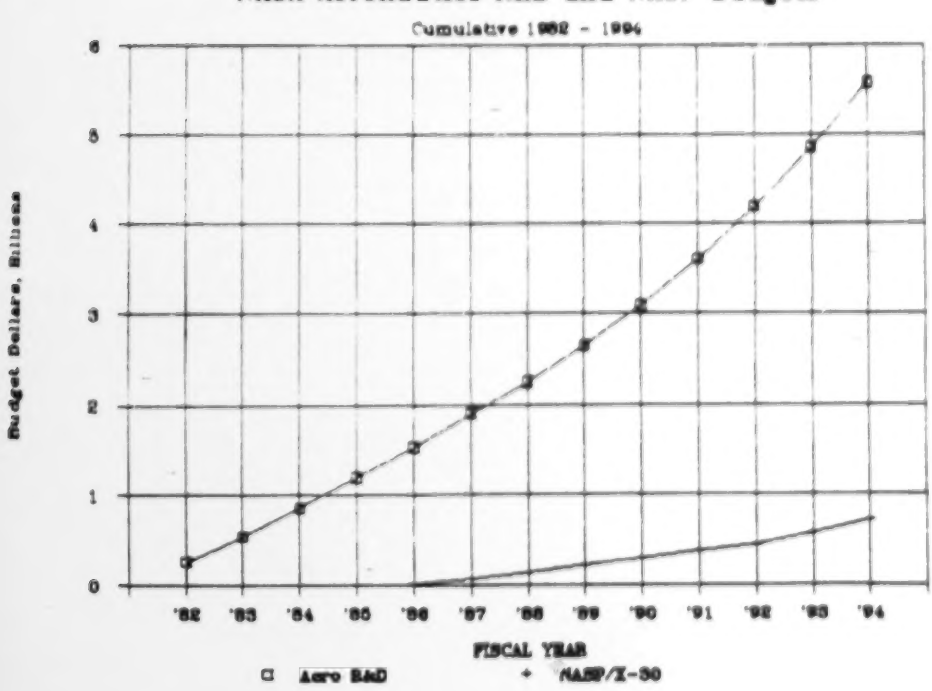

NASA Aeronautics R&D and NASP Budgets
Annual Actuals, Requests, & Estimates
Budget Dollars, Millions
800
700
600
500
400
300
200
100
0
'82 '83 '84 '85 '86 '87 '88 '89 '90 '91 '92 '93 '94
FISCAL YEAR
Aeronautical R&D
NASP/X-30


NASA Aeronautics R&D and NASP Budgets
Cumulative 1982 - 1994
Budget Dollars, Billions
6
5
4
3
2
1
0
'82 '83 '84 '85 '86 '87 '88 '89 '90 '91 '92 '93 '94
FISCAL YEAR
Aero R&D
NASP/X-30

The CHAIRMAN. The Chair would like to get started. We are meeting here this morning on this historic occasion to markup the NASA bill which is the first markup of the committee this year. It's also my first markup as Chairman and obviously I will be feeling my way as we go along here, but I think we are ready to move ahead expeditiously.

In the normal course, I have a brief opening statement here which I will go over quickly. We are going to take up both the NASA Authorization Act and the American Technology Preeminence Act. Obviously the NASA Act is essential to maintaining a productive and forward-looking civilian space program.

The American Technology Preeminence Act is essential for the Nation to begin to regain the lost ground in important technologies and maintain our lead in others, even though we may still be competitive. We have tried to move quickly to bring legislation to the full committee and I have asked all of the subcommittees to act with both prudence, and to be sensitive to the practical limitations that the budget agreement of last year places on us.

I want to say that I am quite pleased with the way the NASA subcommittee has gotten us off to a good start. I think Mr. Hall and Mr. Sensenbrenner are to be commended for the leadership that they've shown, and likewise Mr. Valentine and Mr. Lewis on their part of the NASA Authorization.

It is not easy under any circumstance to go contrary to practices of the past, as reflected in our treatment of NASA legislation, and to begin to apply different and more rigorous standards, as the subcommittee has done. I am sure this has created some tension and some problems for them. I think in hindsight, we will find that the subcommittee has acted wisely and it will increase our ability to support NASA. That at least is my hope, that this will produce a better and stronger degree of Congressional support for the NASA program.

The bill before us incorporates a number of meritorious actions which are explained fully in the draft report. It, as I indicated, contains a number of program reductions which I know were difficult. The net change is a $488 million reduction. I have, in the interests of preserving some degree of fiscal discipline, I ask that members offering amendments that would increase program funding to identify corresponding specific offsets, and only by doing this can we maintain an overall funding level that is within the realm of budget reality and can we have a real impact on the final budget priorities. Once again, I want to commend the subcommittees for bringing this legislation before us today.

[The prepared opening statement of Chairman Brown follows:]

OPENING STATEMENT
OF THE HONORABLE GEORGE E. BROWN, JR., CHAIRMAN
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
ON THE
FULL COMMITTEE MARKUP OF THE NASA BILL

April 24, 1991

Today, the Committee meets to mark up two very important pieces of legislation, the National Aeronautics and Space Administration Multiyear Authorization Act of 1991, and the American Technology Preeminence Act. The first is essential to maintaining a productive and forward-looking civilian space program. The second is essential for the Nation to regain lost ground in important technologies and to maintain our lead in others where we are still strongly competitive.

We have tried to move quickly this year in bringing legislation to Full Committee. I have also asked all of the Subcommittees to act with the utmost prudence and to be sensitive to the practical limitations that last year's budget agreement will place on us. I am pleased that the NASA bill has provided a good start for us in that regard. I want to commend Mr. Hall and Mr. Sensenbrenner for the leadership they have shown on the Subcommittee on Space, and Mr. Valentine and Mr. Lewis on the Subcommittee on Technology and Competitiveness.

The NASA bill before the Committee incorporates a number of very meritorious actions which are explained fully in the draft report. It also contains a number of program reductions which I know were difficult to make. The net change to the NASA request is a $488 million reduction. I would ask Members offering

amendments today that would increase program funding to identify corresponding specific offsets. Only by maintaining an overall funding level that is within the realm of budget reality can we hope to have a real impact on the final budget priorities.

Once again, I want to commend the Subcommittees for bringing this legislation before us today and I look forward to successful completion.

I now would like to turn to Mr. Walker for any opening statement he might have.

Mr. WALKER. Mr. Chairman, I view the NASA Authorization Bill that comes to us today with some mixed feelings. On one hand, I fully understand the climate which prompted the Space Subcommittee to mark up a bill which is nearly a half-billion dollars less than the President's request.

On the other hand, I have serious reservations about the signal that we on the Science Committee send when we fail to back the President's strong commitment to science. I will insist, as we continue our work to mark up bills in the full committee in the coming weeks, that we take an equally hard look at the other departments and agencies under our jurisdiction, and apply the same appropriations reality test that we have used here on the NASA Authorization Bill. I think we will make a mistake as a committee if, at some point, it is interpreted that what we did was cut NASA in order to come up with more money for the accounts of other deserving but also committees and departments that have to live within budget realities. So, I think that we do need to be very careful as we start down this road.

The committee received a letter from Admiral Truly last evening describing NASA's position on this bill. Some of the administration's concerns will be dealt with in amendments offered this morning. In particular, I would urge that the utmost flexibility be given to NASA to transfer money from within the space shuttle production and operation capability account and that the space shuttle operations account so that we can the increase that we have made for ASRM can be adequately absorbed.

Later I will offer several amendments that will strengthen our Nation's space efforts, and with their inclusion, I can support and sponsor this bill. I will discuss these changes at the appropriate time.

Mr. Chairman, I am pleased that we are considering this legislation before the appropriations process gets underway. I urge prompt action on this bill today, and I urge you to take all necessary steps to bring it before the full House as soon as possible.

[The prepared opening statement of Mr. Walker follows:]

OPENING STATEMENT FOR THE HONORABLE ROBERT S. WALKER
MARKUP OF THE NASA MULTIYEAR AUTHORIZATION ACT OF 1991
APRIL 24, 1991

Mr. Chairman, I view this NASA authorization bill with mixed feelings. On one hand, I fully understand the budget climate which prompted the Space Subcommittee to mark up a bill which is nearly half a billion dollars less than the President's request. On the other hand, I have serious reservations about the signal we on the Science Committee send when we fail to back the President's strong commitment to science.

I will insist that as we continue to mark up bills in full Committee during the coming weeks, we will take an equally hard look at the other departments and agencies under our jurisdiction and apply the same "appropriations reality test" that we have used here for the NASA authorization bill.

The Committee received a letter from Admiral Truly last evening describing NASA's position on the bill. Some of the Administration's concerns will be dealt with amendments offered this morning. In particular, I would urge that the utmost flexibility be given to NASA to transfer money from within the space shuttle production and operation capability account and the space shuttle operations account so that the increase we have made for ASRM can be adequately absorbed.

Later, I will offer several amendments which will strengthen our nation's space efforts, and with their inclusion I could support and sponsor this bill. I will discuss these changes at the appropriate time.

Mr. Chairman, I am pleased that we are considering this legislation before the appropriations process gets underway. I urge prompt action on this bill today, and I urge you to take all the necessary steps to bring it before the full House as soon as possible.

The CHAIRMAN. I thank the ranking minority member. The Chair intends to recognize the Chairman and ranking member of each of the two subcommittees to present their subcommittee reports, and following that, we will recognize other members, if any, for remarks or opening statements on the subcommittee reports. So, at this point, I would like to recognize Chairman Hall of the Space Subcommittee to present the subcommittee report.

Mr. HALL. Mr. Chairman, could I defer to my colleague from the other side, Mr. Sensenbrenner at this time. I haven't read my opening statements yet.

The CHAIRMAN. Well, that is a serious problem. You could just put it in the record of course.

Mr. HALL. Yes, and I may just do that.

The CHAIRMAN. The Chair will be happy to recognize Mr. Sensenbrenner.

Mr. SENSENBRENNER. Thank you very much. It gives the Republicans the last word, and that doesn't happen very often here. But I am proud to be an original cosponsor of this bill. I think it represents a realistic setting of priorities for NASA, given today's constrained budget climate.

In the past, this committee has shot for the moon and run out of gas half way there. The Appropriations Committee has jumped in and filled the vacuum and set forth our space policy in manners which I don't think this committee agrees with. The time has come for this committee to reassert itself to use the expertise that we have in developing priorities for NASA, and hopefully having a little bit more input in the process on how the NASA budget pie is divided for fiscal year 1992.

I received the letter last night from Admiral Truly as well. I would point out that even with the cuts of over $450 million for the next fiscal year, this bill represents a 10-percent increase in budget authority for NASA. That is a pretty hefty increase, given the constraints of what this Congress did last October in setting forth the budget agreement and writing the road map for the consideration of budget issues for this year and the next two fiscal years.

I am proud of supporting a bill with a 10 percent increase. I am sorry that we don't have the money available to give NASA everything they want, but I do think this will be a salutary addition to the process, because when the time comes for the Appropriations Committee to do its thing, I think you will see a lot more input from this committee and NASA will be stronger as a result of it. So, I would like to commend both Chairman Brown and chairman Hall for their efforts along these lines. I think we are going to do the committee proud by the time the last word is said on the fiscal 1992 budget for NASA.

The CHAIRMAN. The Chair appreciates those remarks from Mr. Sensenbrenner and concurs with them completely. Chairman Hall, are you prepared to make your statement now.

Mr. HALL. Thank you, Mr. Chairman. Mr. Chairman, I too am pleased that you have called this meeting today to complete the markup of the NASA Multiyear Authorization Bill of 1991. The legislation, as Mr. Sensenbrenner said, is very important and the committee has an opportunity this year, I think, to maintain its place in the budget process. The Subcommittee on Space met on

April 10 and 11 to consider this bill, and it was favorably reported to the full committee without objection. The gentleman from New Jersey, Mr. Zimmer, had objected to some parts of the bill, but has advised me that he favors the space program. He certainly is a supporter of the space program and I think he will have an opportunity to make that a little more clear to us when he is recognized. I voted him against the program on the final vote and I was in error in doing that. I misunderstood the gentleman. I understood that I got him some very good press in his district with that vote, but perhaps he wants to straighten that out when he has the opportunity.

Mr. Chairman, I might also add that in the interest of providing the taxpayer the full benefit of their elected representatives, our committee has agreed, not unanimously, but to begin and adopt a policy of beginning our markups at 8:00 in the morning. We found it to be very successful when we put in a good, full day's work, and some who might have opposed some parts of it, maybe do not want to get up at 8:00 in the morning, but I think it was a good way to start our subcommittee out.

Mr. Chairman, the Space Subcommittee approached its legislative year with a view of producing a bill that I think will be a realistic reflection of NASA's budget needs, but one that also reflects the budget realities that we all know we are going to be facing. We undertook extraordinary efforts to identify all conceivable areas in which funding could be deferred or reduced, and this was made really all the more difficult by the fact that the President's request was, by any measure, a very reasonable and prudent one. The decisions we made were difficult ones, but ones we feel were very necessary.

The bill provides $14.2 billion for NASA's space related activities. Although this is a reduction of $488 million from the President's request, it nevertheless represents a 10 percent nominal increase over 1991, or a five to six percent real increase. So, we really didn't cut the budget. This increase can be compared to the growth recommended by the advisory committee on the future of the U.S. space program that was headed by Norm Augustine, and we had his report here and his testimony in person. That report recommended a 10 percent annual real growth, and this is highly desirable, but we really just didn't feel that we could accommodate that this year. The level contained in our bill, which is a five to six percent real growth represents what I would consider the minimum Congress should consider.

I also point out that the subcommittee recommendations includes funding for NASA's science programs which is 20 percent of the overall NASA budget. This reflects the goal recommended by the Augustine panel. In the area of advanced space technology, another program recommended by the Augustine panel for special consideration, the subcommittee's bill provides funding which is over three percent of the total NASA program budget. We will need to continue to increase our investment in this area.

We have provided, Mr. Chairman, full funding for the space station, but we set aside $129 million to become available upon the submission of a report by the National Research Council on NASA's restructuring plan and the potential to evolve the station.

The subcommittee debated at great length the need for the new launch system proposed by the administration. Although many members agree in principal with the need for the program and my own mind remains open on the issue, more work is really needed to define the roles and missions for such a vehicle. Thus, we provided some sustaining funding and we look forward to working with NASA and the administrators as their plans become a little bit more clear to us.

Mr. Chairman, we have made a number of other adjustments to NASA's request in the subcommittee bill, and I know that some of these will be the subject of discussion today. I would only say that we were motivated to identify specific reductions which least impacted the health of the space station in the long term. All of NASA's proposed programs have great merit in and of themselves, but we are cognizant that reductions will need to be made this year, and it is important that we make careful judgments on the overall priorities we wish to recommend to other committees.

Mr. Chairman, the text of the subcommittee draft report contains a full explanation of the subcommittee's recommendations. This concludes my report and I will be very happy to answer any questions, and I thank the chair.

[The prepared opening statement of Mr. Hall follows:]

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. House of Representatives
Washington, DC 20515

April 22, 1991

MEMORANDUM

TO: *Chairman Brown*

FROM: *Ralph Hall, Chairman*
Subcommittee on Space

SUBJ: *Subcommittee Markup of the NASA Multiyear Authorization Act of 1991*

Background and Purpose of the Legislation

On April 10 and 11, the Subcommittee on Space marked up the Committee print of the National Aeronautics and Space Administration Multiyear Authorization Act of 1991. This Bill contains budget authority and program guidance for NASA, the Department of Transportation Office of Commercial Space Transportation, the Department of Commerce Office of Space Commerce, and the National Space Council.

The Bill authorizes NASA's research and development and operational programs for fiscal years 1992 through 1994, except for the Space Station for which budget information for fiscal years 1993 and 1994 are not yet available.

Major Provisions of the Bill

Major provisions of the Bill recommended by the Subcommittee are as follows:

- *The Bill provides a total of $14.274 billion for NASA's space related activities, a reduction of $488 million from the requested level for FY 1992.*
- *The level authorized for FY 1992 represents an increase of 10% over FY 1991. This is an increase of 5 to 6% in real dollars.*
- *Funding for a balanced science program has been maintained at 20% of the total NASA program budget.*
- *Funding for basic space technology is 3.1% of the total NASA program budget, up from its FY 1991 level of 2.5%.*

- *The Bill provides full funding for the Space Station Freedom with $128.9 million to be provided upon the submission of a report from the National Academy of Sciences on the restructuring plan for the Station, its potential to evolve, and the potential to carry out life science research.*

- *The Bill provides sustaining funding for the definition of a New Launch System and ensures the continuation of the Space Transportation Main Engine program.*

- *A program of component technology research and development has been established to assist the commercial space launch industry.*

- *Funding has been provided for the Advanced Solid Rocket Motor program in order to allow it to support the Space Station assembly requirements and schedule.*

- *The sense of Congress has been expressed that the National Space Council should develop policy recommendations for the follow-on program to Landsat 6.*

OPENING STATEMENT OF
THE HONORABLE RALPH HALL
CHAIRMAN OF THE SUBCOMMITTEE ON SPACE
FOR
FULL COMMITTEE MARKUP OF
THE NASA AUTHORIZATION BILL OF 1991

April 24, 1991

REPORT TO THE FULL COMMITTEE

MR. CHAIRMAN, I AM PLEASED THAT YOU HAVE CALLED THIS MEETING TODAY TO COMPLETE MARKUP OF THE NASA MULTIYEAR AUTHORIZATION BILL OF 1991. THIS LEGISLATION IS IMPORTANT AND THE COMMITTEE HAS AN OPPORTUNITY THIS YEAR TO MAINTAIN ITS PLACE IN THE BUDGET PROCESS.

THE SUBCOMMITTEE ON SPACE MET ON APRIL 10 AND 11 TO CONSIDER THIS BILL AND IT WAS FAVORABLY REPORTED TO THE FULL COMMITTEE WITHOUT OBJECTION. I MIGHT ALSO ADD THAT IN THE INTEREST OF PROVIDING THE TAXPAYER THE FULL BENEFIT OF THEIR ELECTED REPRESENTATIVES, THE SPACE SUBCOMMITTEE ADOPTED A POLICY OF BEGINNING ITS MARKUPS AT 8:00 AM.

MR. CHAIRMAN, THE SPACE SUBCOMMITTEE APPROACHED THIS LEGISLATIVE YEAR WITH A VIEW OF PRODUCING A BILL THAT WILL BE A REALISTIC REFLECTION OF NASA'S BUDGET NEEDS BUT ONE THAT ALSO REFLECTS THE BUDGET REALITIES THAT WE ALL KNOW WE WILL BE FACING. THUS WE UNDERTOOK EXTRAORDINARY

EFFORTS TO IDENTIFY ALL CONCEIVABLE AREAS IN WHICH FUNDING COULD BE DEFERRED OR REDUCED. THIS WAS MADE ALL THE MORE DIFFICULT BY THE FACT THAT THE PRESIDENT'S REQUEST WAS, BY ANY MEASURE, A REASONABLE AND PRUDENT ONE. THE DECISIONS WE MADE WERE DIFFICULT ONES BUT ONES THAT WE FEEL WILL BE NECESSARY.

THE BILL PROVIDES $14.274 BILLION FOR NASA'S SPACE RELATED ACTIVITIES. ALTHOUGH THIS IS A REDUCTION OF $488 MILLION FROM THE PRESIDENT'S REQUEST, IT NEVERTHELESS REPRESENTS A 10% NOMINAL INCREASE OVER 1991, OR A 5 TO 6% REAL INCREASE. THIS INCREASE CAN BE COMPARED TO THE GROWTH RECOMMENDED BY THE ADVISORY COMMITTEE ON THE FUTURE OF THE U.S. SPACE PROGRAM HEADED BY NORMAL AUGUSTINE. THAT REPORT RECOMMENDED A 10% ANNUAL REAL GROWTH. THIS IS HIGHLY DESIRABLE BUT PROBABLY CANNOT BE ACCOMMODATED THIS YEAR. THE LEVEL CONTAINED IN OUR BILL, 5 TO 6% REAL GROWTH, REPRESENTS WHAT I WOULD CONSIDER THE MINIMUM CONGRESS SHOULD CONSIDER.

I WOULD ALSO POINT OUT THAT THE SUBCOMMITTEE RECOMMENDATIONS INCLUDES FUNDING FOR NASA'S SCIENCE PROGRAMS WHICH IS 20% OF THE OVERALL NASA BUDGET. THIS REFLECTS THE GOAL RECOMMENDED BY THE AUGUSTINE PANEL. IN THE AREA OF ADVANCED SPACE TECHNOLOGY, ANOTHER PROGRAM

RECOMMENDED BY THE AUGUSTINE PANEL FOR SPECIAL CONSIDERATION, THE SUBCOMMITTEE'S BILL PROVIDES FUNDING WHICH IS OVER 3% OF THE TOTAL NASA PROGRAM BUDGET. WE WILL NEED TO CONTINUE TO INCREASE OUR INVESTMENT IN THIS AREA.

WE HAVE PROVIDED FULL FUNDING FOR THE SPACE STATION BUT WE HAVE SET ASIDE $129 MILLION TO BECOME AVAILABLE UPON THE SUBMISSION OF A REPORT BY THE NATIONAL RESEARCH COUNCIL ON NASA'S RESTRUCTURING PLAN AND THE POTENTIAL TO EVOLVE THE STATION.

THE SUBCOMMITTEE DEBATED AT GREAT LENGTH THE NEED FOR THE NEW LAUNCH SYSTEM PROPOSED BY THE ADMINISTRATION. ALTHOUGH MANY MEMBERS AGREE IN PRINCIPLE WITH THE NEED FOR THIS PROGRAM AND MY OWN MIND REMAINS OPEN ON THE ISSUE, MORE WORK IS NEEDED TO DEFINE THE ROLES AND MISSIONS FOR SUCH A VEHICLE. THUS WE HAVE PROVIDED SOME SUSTAINING FUNDING AND WE LOOK FORWARD TO WORKING WITH NASA AND THE ADMINISTRATION AS THEIR PLANS BECOME CLEARER.

MR. CHAIRMAN WE HAVE MADE A NUMBER OF OTHER ADJUSTMENTS TO NASA'S REQUEST IN THE SUBCOMMITTEE BILL AND I KNOW THAT SOME OF THESE WILL BE THE SUBJECT OF DISCUSSION TODAY. I WOULD ONLY SAY THAT WE WERE MOTIVATED TO

IDENTIFY SPECIFIC REDUCTIONS WHICH LEAST IMPACTED THE HEALTH OF THE SPACE PROGRAM IN THE LONG TERM. ALL OF NASA'S PROPOSED PROGRAMS HAVE GREAT MERIT IN AND OF THEMSELVES BUT WE ARE COGNIZANT THAT REDUCTIONS WILL NEED TO BE MADE THIS YEAR AND IT IS IMPORTANT THAT WE MAKE CAREFUL JUDGEMENTS ON THE OVERALL PRIORITIES WE WISH TO RECOMMEND TO OTHER COMMITTEES.

MR. CHAIRMAN, THE TEXT OF THE SUBCOMMITTEE DRAFT REPORT CONTAINS A FULL EXPLANATION OF THE SUBCOMMITTEE'S RECOMMENDATIONS. THIS CONCLUDES MY REPORT AND I WILL BE HAPPY TO ANSWER ANY QUESTIONS.

The CHAIRMAN. Thank you very much Chairman Hall. The Chair now recognizes Mr. Valentine, chairman of the Technology and Competitiveness Subcommittee for his report on the aeronautics portion of the NASA bill.

Mr. VALENTINE. Thank you, Mr. Chairman. Mr. Chairman, the Technology and Competitiveness Subcommittee has unanimously reported the aeronautics and trans-atmospheric portions of the NASA Multiyear Authorization Act of 1991. The 1992 share of the NASA authorization amounts to some $1.122 billion, which was the President's request. We just think this to be a well balanced and well supported request which sustained the continuity of essential transonic and supersonic research. Further, it supported expanding areas of new development in response to the requirements of the National Aerospace Plane.

The annual aeronautics product of the United States exceeds $90 billion, and that provides the best of our favorable industrial trade balance of some $25 billion. Aeronautics employs a million Americans; air transport carries twice the U.S. population annually. This very American profile is no accident. We have been determined to assure our continued improvement of the excellence of our world leadership in aeronautics.

The National Aerospace Plane authorization, which is $72 million of the $448 million aeronautical technology base, is a national program shared with the Department of Defense and five major industrial firms. The NASP is the rare kind of program that is already paying its way in research results, and is also a known quantity in what will contribute to the continuance of our air space excellence well into the 21st century.

Mr. Chairman, we submit a completely and, we believe, carefully prepared bill for full committee acceptance. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much Mr. Valentine. Mr. Lewis, we recognize you for your comments on this.

Mr. LEWIS. Thank you, Mr. Chairman. The aeronautics portion of the NASA bill H.R. 1988 before us is a bipartisan effort that reflects the various interests of the members. I must say, Mr. Chairman, it is a pleasure working with the gentleman from North Carolina, Mr. Valentine.

First of all, the budget totals reflect the administration's request for fiscal 1992, 1993, and 1994. Moreover, the aeronautics funding levels are the same as those contained in the Brown/Walker March 15, 1991 submission to the budget committee.

Secondly, the report language submitted by the Technology and Competitiveness Subcommittee contains portions requested by Mr. Walker from Pennsylvania and Mr. Rohrabacher from California. Finally, the bipartisan legislation passed the subcommittee unanimously.

I think the reason for the strong support of the NASA aeronautics budget is the importance of the research program. As many of you know, the largest positive balance of trade in any United States sector is aeronautics. Estimates place a positive trade balance for 1990 at $25 billion. Credit for the U.S. technological advantage is the long term, high risk NASA research that has led to many of the advances in aeronautics.

In conclusion, the NASA aeronautics research program is very important and I think that the fact that it passed the subcommittee as a unanimous bipartisan package reflects that the members agree. I want to thank you, Mr. Chairman and the Ranking Member, Mr. Walker, for the leadership in bringing this before the committee so quickly. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much Mr. Lewis. The Chair will now recognize any other members for opening statements before we entertain a motion to adopt the subcommittee report. The gentleman from Maryland.

Mr. MCMILLEN. Mr. Chairman, I have a brief opening statement that I ask be included in the record. Thank you.

The CHAIRMAN. Without objection. The gentleman from California.

[The prepared opening statement of Mr. McMillen follows:]

STATEMENT OF TOM MC MILLEN

MR CHAIRMAN I COMMEND YOU FOR THE EXPEDITIOUS WAY IN WHICH YOU HAVE BROUGHT THIS NASA AUTHORIZATION TO THE FULL COMMITTEE. WHILE SOME FUNDING ISSUES HAVE YET TO BE RESOLVED, THE EARLY DATE AT WHICH WE ARE MARKING UP THIS BILL WILL ENSURE THAT THE HOUSE WILL CONSIDER THIS BILL AT A TIME WELL BEFORE THE SUMMER RECESS.

WHILE PROGRAMMATIC FUNDING CHOICES HAVE BEEN DIFFICULT, WE NEED TO LOOK FAR INTO THE FUTURE TO DETERMINE WHICH PROGRAMS WILL HAVE THE MAXIMAL PAYOFF FOR THER CIVILIAN SPACE PROGRAM. ONE PROGRAM THAT MEETS THIS CRITERION IS THE EOS PROJECT. A MULTI BILLION DOLLAR PROPOSAL, WE ARE JUST NOW INITIATING THE PRELIMINARY STAGES OF THIS INNOVATIVE PROGRAM. ITS MOST IMMEDIATE ADVANTAGE FOR EARTH SCIENTISTS IS ITS ABILITY TO SUPPLY US WITH VITAL INFORMATION ABOUT THE GLOBAL WARMING TREND, A GREAT CONCERN TO SCIENTISTS AND POLICY MAKERS. ITS NUMEROUS OTHER BENEFITS AND SPIN OFFS SHOULD ENCOURAGE US TO FULLY FUND THIS PROGRAM. FOR THIS REASON, I SUGGEST THAT WE CAREFULLY EXAMINE THE PROPOSED $75 MILL. CUT FROM THE PRESIDENT'S REQUEST BEING PROPOSED. WE NEED TO CAREFULLY CONSIDER THAT CUTS NOW IN THE EOS MAY RESULT IN UNACCEPTABLE COST OVERRUNS AND SCHEDULE DELAYS IN THE FUTURE. THE SCIENCE COMMUNITY HAS CONFIRMED

THE PRIMACY OF THE EOS PROGRAM -- LET'S HAVE THE COURAGE TO FUND IT ADEQUATELY, THIS YR. AND IN FUTURE ONES.

THANK YOU. CTM.

Mr. MINETA. Mr. Chairman, I would like to ask unanimous consent to submit an opening statement.

The CHAIRMAN. Without objection, so ordered. Any other opening statements.

Mr. WOLPE. Mr. Chairman, I would like to make a brief statement. First of all, I would like to applaud the timeliness with which you have scheduled this markup, by your willingness to make some tough decisions, to make them without undue delay, and you have ensured that his committee will be at the center of the national debate on the crucial issues of space policy and industrial competitiveness; trains leaving the station, and I must say we are all delighted to be working with the conductor.

Mr. Chairman, I strongly support the work that you and the gentleman from Texas, Mr. Hall, have done in bringing the NASA bill before us today. Despite the fact that the State of Michigan has no NASA facilities or large aerospace contractors, I am a very strong supporter of NASA's programs, for the simple reason that NASA's work has been and continues to be good for the country as a whole. At the same time, because of the constrained budgetary climate, this committee and this Congress must begin to do a better job of ensuring that the $14 or $15 billion in taxpayer's dollars that are spent on NASA programs are contributing their proportionate share to the scientific, technological and educational development of this country.

I have concerns in two specific areas. First, NASA programs, particularly the largest programs, must be forced to pass a test of scientific credibility. Frankly I continue to have doubts as to whether the space station passes that test, and I hope to work with Mr. Hall during this Congress to assess whether the station redesign and later upgrades will in fact yield useful science. The reason for imposing a scientific relevance test on all such large projects as the station is obvious. As succinctly stated in the recently released OTA report on Federally funded research, and I quote "not all science mega-projects may be supportable without eroding funding for the science base".

My second general concern about the NASA budget relates to the issues of whether appropriate funds are well spent and whether the agencies management systems are under control. The Augustine commission has documented the fact that NASA has had a poor record in these areas over the past decade. In an environment of $300 to $400 billion annual budget deficits, we simply do not have the luxury of supporting programs that lack effective cost controls, contractors who perform shoddy work, or spokespersons who consistently provide the Congress with unrealistically low cost estimates. As chairman of the Investigations and Oversight Subcommittee, I look forward to working closely with Mr. Hall during this Congress to strengthen cost accountability throughout NASA.

Mr. Chairman, I intend to support the NASA bill before us today, with the recognition that we have much work to do before this bill and the HUD independent agency's appropriations bill reach the floor later this session. Until we can show the Congress and the country that these programs are scientifically strong and financial credible, this committee cannot and should not defend NASA programs in an appropriations process which pits space

against pressing national needs for veterans, for housing and urban development, and for the environment. Thank you very much.

The CHAIRMAN. Thank you very much Mr. Wolpe, and we are depending upon you to help us maintain a high quality of performance within NASA and other agencies in our jurisdiction.

Any other comments on the minority side, opening statements? [No response.]

If not, the Chair will recognize Mr. Sensenbrenner for a motion to adopt the subcommittee report.

Mr. SENSENBRENNER. As chairman, I move the adoption of the reports of the Subcommittees on Space and on Technology and Competitiveness on H.R. 1988, the NASA Multiyear Authorization Act of 1991.

The CHAIRMAN. Now, this is not approval. This merely puts the reports before us for further discussion. Is there any debate on the motion? [No response.]

If not, is there any objection to the motion? Hearing none, the motion is adopted.

The Chair would like to ask unanimous consent that it be made in order for the committee to consider a committee print to consider the print as original text for markup and to consider the print as being read and open for discussion at any point. Hearing no objection that will be the order.

Now, the Chair would like to ask any members who have any general comments about the bill to do so, and then we will move immediately to amendments. Any general comments with regard to the legislation before us? Hearing none, the Chair will entertain amendments—oh, Mr. Roemer, certainly.

Mr. ROEMER. Mr. Chairman, this is a difficult decision for me as a new Member, as a freshman Member, but as I campaign for Congress, I said that I would be willing, no matter what committee or what room it was in, to make some of those difficult decisions, and in last year's budget agreement, I think it made some egregiously unfair gaps and walls on new members of Congress to do some things about budget priorities, i.e., trying to get additional monies into education for our kids' future for head start programs, for infrastructure needs throughout this country. I am not an enemy or somebody that wants to see the NASA budget cut or the space station cut unfairly, however, a ten percent increase and a five to six percent real increase in real dollars is one that is very tough for me to see as I go back to my district and see teachers pink-slipped, to see that our children our not getting measle inoculations in the richest country of the world, and that I, with some of my colleagues, are talking about a marshal plan to rebuild this country that includes space as well as our schools, and I will make this quick Mr. Chairman.

A constituency that doesn't vote between the ages of 3 and 18, that doesn't give money, I think that we need to articulate the case for the children of this country and for our future in the schools. I will be voting against the NASA budget this morning because I think we do need to make some of these tough decisions.

Martin Marietta, Lockheed, and Raytheon—they need to have skilled workers. We need to put people in space, have educated astronauts, educated workers, educated people at the top echelons of

these companies, and these CEOs are coming to me and saying that we have a very, very difficult problem with our schools and our children. I just want to reiterate that I would not like to see these programs killed. We have seen what NASA has done in the future with $14 coming back for every dollar invested. I would just like to see a more modest increase and some added emphasis in this marshal plan for our country to rebuild this country and get as competitive again and make the smartest kids coming out of our schools. Thank you for your patience Mr. Chairman.

The CHAIRMAN. Thank you very much Mr. Roemer. I will not state that I agree with the position that you take, but I recognize the validity of that position and the fact that it is held by a number of members who raise legitimate questions about our priorities. We will have to try to make, in this committee, a convincing case for our priority of supporting the research and development budget of this Nation, and to justify it on the same grounds as you are stating—that we need to improve the quality of life in this country and I hope we will be able to do that.

Mr. ROEMER. Mr. Chairman, thank you for your comments and that includes spending more money on our science and math programs in this committee. Thank you sir.

The CHAIRMAN. The Chair will take up the amendments in the order in which they are listed in the list that you have before you. I assume you all have it before you. The first one in order, Amendment A, offered by Mr. Torricelli.

Mr. TORRICELLI. Mr. Chairman, if I could ask that you ask to accept the amendment. Actually, it should read lines 12 through 15.

The CHAIRMAN. Without objection, the technical correction will be made in the amendment.

Mr. TORRICELLI. Mr. Chairman, may I proceed to describe the amendment?

The CHAIRMAN. The gentleman is recognized.

Mr. TORRICELLI. Mr. Chairman, the private launch industry for space services was born in this committee. It is our product. A number of American companies followed our lead and indeed captured our vision. They invested millions of dollars in the creation of what remains an infant industry to provide private launch services.

Although we began that effort, we were hardly alone in it. Indeed in the Bush administration, his policy was embraced by the National Space Policy directive which said, and I quote "The continued use of U.S. manufactured launch vehicles for launching U.S. Government satellites should remain our policy." Indeed, now the USTR, in negotiating the with Europeans about opening free trade in launch services, has a foundation of those negotiations that while we believe both Europe and the United States should open up services for launching private satellites, as a policy of the Bush administration, we refuse to put on the table the launching of U.S. Government satellites, and appropriately so. Indeed if there is to be a private launch industry in this country, there must be a reserve of U.S. Government satellites for that industry.

I am aware of only one contradiction to this policy of the Reagan/Bush administrations and this committee. It is in the mark

that is before us which includes the language on page 3, lines 12 through 15, and I quote "policies which restrict the use of foreign launch capabilities for U.S. Government satellites should apply only where adequate United States launch capabilities exist."

In fairness, Mr. Chairman, there is a question, a judgment to be made, with mission to planet earth about availability of domestic launch services. Some modifications would be required, but the multi-million dollar investment this Congress made in Vandenberg, and existing launch capabilities, can be adjusted at relatively modest cost so there is a U.S. Government, a U.S. industry capability.

There will be 18 launches in this series. For the price of two or three, this capability can be made whole, or with adjustments in the program, far less. In any case, Mr. Chairman, my amendment raises this issue once again. I believe we should remain consistent with the judgment of this committee, the trade position maintained by the Bush administration, and indeed the space council which we have hithertofore endorsed in maintaining a U.S. Government exclusivity with U.S. industry in launching our own Government satellites. That Mr. Chairman, I offer this amendment and trust that it would receive supports on both sides of the aisle.

[The amendment roster plus the amendment offered by Mr. Torricelli follows:]

COMMITTEE MARKUP
April 24, 1991

AMENDMENT ROSTER

1. H.R. 1988, the National Aeronautics and Space Administration Multiyear Authorization Act of 1991

Amendments

	Sponsor	Description
a)	Mr. Torricelli	Strike finding on foreign launch services.
b)	Messrs. Bacchus and Lewis	Finding relating to launch sites and launch site support facilities.
c)	Mr. Walker	Substitute for 4(a)(1)(A) regarding funds for the Space Station.
d)	Mr. Walker	Substitute for 4(a)(1)(B) regarding funding for space transportation capability and development.
e)	Mr. Henry	Restores FY 93 and FY 94 funds for AXAF.
f)	Mr. Brown	Long-lead parts for follow-on to Landsat 6.
g)	Mr. Bacchus	Redirect funds for commercial launch vehicle R&D from Space Research and Technology.
h)	Mr. Bacchus	Redirect funding for Flight Telerobotic Servicer.
i)	Mr. Walker	Redirect funding for Space Exploration Initiative.
j)	Messrs. Bacchus and Lewis	Space infrastructure amendment.
k)	Mr. Traficant	New Section: "Restrictions on Contract Awards."
l)	Mr. Traficant	New Section regarding fraudulent use of "Made in America" labels.
m)	Mr. Traficant	New Section: "Buy American Requirement."
n)	Mr. Brown	New section regarding NASA quality assurance personnel.

o)	Messrs. Brown and Lewis	New section: NASA Endeavor Teacher Fellowship Trust Fund
p)	Mr. Zimmer	New section requiring National Academy of Science assessment of space-based research and Space Station alternatives.

Report Language

q)	Mr. Torricelli	Strike report language relating to foreign launch services.
r)	Mr. Henry	Substitute report language relating to AXAF.
s)	Mr. Brown	Amend report language relating to Earth Science and Applications and add new Committee View on Long-Lead Parts for Follow-on to Landsat 6.
t)	Mr. Stallings	Additional Committee View on High Capacity Power.
u)	Mr. Bacchus	New report language relating to Amendment (h) on the Flight Telerobotic Servicer (FTS).
v)	Messrs. Bacchus and Lewis	Committee View on "Improvements of Space Transportation Infrastructure."
w)	Mr. Walker	New report language relating to the Single Stage to Orbit program.

2. H.R. 1989, the American Technology Preeminence Act of 1991

Amendments

	Sponsor	Description
a)	Mr. Mineta	Redirect funds for and establish a Technology Commericalization Loan Fund.
b)	Mr. Brown	Metric Amendment to the Fair Packaging and Labeling Act.
c)	Mr. Brown	Scientific and Technical Information: timely transfer to NTIS and annual report to Congress.

d)	*Mr. Valentine*	*Transfer of surplus federal research equipment.*
e)	*Mr. Walker*	*Technical amendment regarding administering the Malcolm Baldrige National Quality Award program.*

Report Language

f)	*Mr. Thornton*	*Additional View*
g)	*Mrs. Morella*	*NIST Demonstration Project Successes*

AMENDMENT TO COMMITTEE PRINT

OFFERED BY MR. TORRICELLI

H.R. 1988; NASA AUTHORIZATION

Page 3 Lines 13 through 17, strike paragraph (8).

Redesignate subsequent paragraphs accordingly.

The CHAIRMAN. Is there any member who desires to speak on this amendment?

Mr. ROHRABACHER. A question for Mr. Torricelli. This does not in any way effect the private launches?

Mr. TORRICELLI. This in no way effects private launches. As you know, it is the policy of the administration and of this committee that we should enter into a free competition in private launches, hoping that the Europeans and the current USTR negotiations will allow U.S. companies to have access to launching those services, as they would have for ours. We do not want to interfere with that. That is our goal. This would only maintain the current U.S. trade position that we reserve U.S. Government satellites to the United States.

The CHAIRMAN. Mr. Walker?

Mr. WALKER. Mr. Chairman, while I understand what the gentleman is attempting to do in the hope that obviously we would always opt for U.S. Government rides or for commercial rides for U.S. Government satellites. The fact is that under the policy that the gentleman is defending, even if we had a satellite where there was no other option available, we wouldn't be able to launch that satellite, be it a national security satellite, whatever we are doing. If we have an environmental satellite that we want to go that is going to give us good information, if there was no U.S. ride available for it, the fact is we couldn't launch it. In all the language that I see is suggesting here is that as long as there are U.S. rides available, you would have to use the U.S. ride. If a U.S. ride for some reason, whatever reason, is not available, then you could look at the other alternatives.

I think it makes a somewhat difficult position for someone who has a priority launch to get underway to suggest to them that they cannot shop the market for it if the U.S. market is totally closed to them. That is my reading of what the language here says, and to adopt the gentleman from New Jersey's amendment would suggest that we ought not allow people in Government agencies to shop the market even if we are in a position of having a dire emergency.

Mr. TORRICELLI. As the gentleman is aware, and particularly the national security satellites, the satellites from the outset of their design are planned for a launch system. So indeed, in all U.S. security satellites, there is a system in mind which are only several in nature and exclusively United States I don't believe the security satellites become a consideration. Even if they did——

Mr. WALKER. If the gentleman would let me reclaim my time just for a moment, that is true in the systems that we now have. The fact is that as we end up with a lot more in the way of simplified satellites with smaller technology and so on, it may well be that in the future we can find commercial rides for even some of those satellites, and that we might have the ability, for instance, to build a satellite before a launch system was available. Under the approach you are asking us to take here, we can't even begin to explore those options if we are going to remain with the status quo regardless if that doesn't make any——

Mr. TORRICELLI. The gentleman, while he raises an interesting possibility, the gentleman full well knows the United States Government is never going to launch a security system, an observation

satellite, something important to national security, on a foreign satellite. That simply, for security reasons, is never going to happen. I suspect as a part of the reason why the Bush administration, while I don't know it for a fact, wants to keep this issue out of trade negotiations.

I think the issue is more property framed, or the gentleman's point is more legitimate on the question of scientific payloads which in the future we might find restrictions on, and indeed we might. But as we know, these satellites are designed with a system in mind. If you open this door today, indeed people are going to design satellites which can only be served by some foreign system. This is not something where you can simply move from launcher to launcher. You need to know this somewhat at the outset. The critical point here is that if you allow this to occur, people are going to exit. While the gentleman's points are well-intentioned, and I share his objective, the final result will be private industry will exit the system. They will exit the competition.

Mr. WALKER. Once again, if the gentleman will allow me to reclaim my time, I think the gentleman is refusing to recognize that the future may be very different from the present. We may not need to have a specific launch system for specific vehicles in the future. In fact, one of the things that is going to help the commercial development is when we can deal with both generic launch systems and generic vehicles so that they can be switched among systems. We are arriving at the technology capability to be able to do that at the present time. The gentleman will preclude that in what he does by insisting that we stay with the concept of vehicles specifically designed for missions.

All I am suggesting is that why would we foreclose the future in order to stick with the present by saying that in no case can you ever think about another kind of launch system. I think it makes it very clear in this policy, if there is a U.S. Government vehicle available or if there is a U.S. commercial vehicle available, then you have to take that ride. But if there's not, then we ought to give some latitude for people to shop the marketplace.

Mr. TORRICELLI. If I could—I do not disagree with all the gentleman's points, and indeed if the market were to change and the situation were to change, we can revisit this in the future. But I know the gentleman is also sensitive to the difficulties of the executive being in negotiations. We are now in negotiations with the Europeans on this very issue. The administration has maintained a strong position that we want maximum access on both sides of the Atlantic for private services, we want to reserve this position. If this committee were to allow this to go forward today, we would fundamentally undermine not only the previous work of the committee, but more importantly, the USTR in current negotiations.

I would ask that we not do that, that the gentleman's points are valid, we can revisit them in the future, if we see there are payloads better served by foreign launchers—what is important is to have the launches take place. I am open about it in the future, but let's allow this to go ahead today as we have done so, and we will revisit it if it is necessary. I would like to thank the gentleman for yielding his time.

Mr. WALKER. I would simply say to the gentleman as the Ranking Republican on the committee, I have no information whatsoever from USTR that they have any problem at all with the language that is in the bill.

Mr. TORRICELLI. Which has only happened yesterday.

The CHAIRMAN. Would the gentleman from Texas like to be recognized?

Mr. HALL. Yes, I would like to speak against the amendment.

The CHAIRMAN. The gentleman is recognized.

Mr. HALL. Mr. Chairman, actually this amendment would just wipe out the finding that was adopted at the subcommittee level, and while that is not exactly a no-no, and the gentleman has put a lot of thought into it and I understand that, actually the finding on foreign launch services is related to the problem that NASA now faces regarding the EOS system. That is, even though a smaller platform might be more efficient, NASA had assumed that there would be no West Coast launch capability between Delta, which is too small, and the Titan which is too large. So, NASA has over-designed its EOS program to fully utilize the available capacity on a Titan. There is an existing national launch policy, and that is stated in our findings by the space council in September of 1990 to restrict U.S. satellites to U.S. vehicles unless specifically exempted by the President. I think that needs to be in there. Unless NASA believes it would be precluded from using a more efficiently sized launch vehicle such as the Ariane or for launching EOS, even though the cost of the EOS platform could be reduced.

I guess the major thing that I am trying to say here is that the finding that we adopted encourages the development of a U.S. launch capability when it is needed. This is a primary priority. But if that is not possible or if that is too expensive, then NASA shouldn't be precluded from using foreign launch vehicles, if their use would contribute to a more excellent and cost-effective science program.

The gentleman from Ohio may be wincing a little, but let me go further and give you some more of the finding that we adopted. In no case would a foreign launch vehicle take business away from a U.S. launch company, since this finding only allows the use of foreign vehicles only where no U.S. capability will exist. So, I think that we need the finding that we adopted at the subcommittee. We may need to use another platform, someone else's technology. We may have to swallow some of our pride and we may learn from using this, or we may even get a leg up on finding some dreaded disease cures. I think that we need the finding that was adopted at the subcommittee and I respectfully appreciate the gentleman from New Jersey's time and efforts and his very good explanation of it. I just feel that we need this finding in this report.

Mr. HENRY. Mr. Chairman.

The CHAIRMAN. Who seeks recognition? Mr. Henry?

Mr. HENRY. Thank you, Mr. Chairman. It strikes me that there is eminent reasonableness to Mr. Torricelli's amendment and to my distinguished ranking member, Mr. Walker, as you speak of the changing technologies and the interchangeability of launch mechanisms and the capacity of designing your payload to match the

launch, that is all the more argument for Mr. Torricelli's amendment.

I want to remind members of the committee that under existing policy, the President does have the right, if I'm not mistaken, to in fact authorize the launch of an American payload on a foreign launch or foreign lift, whenever he deems that necessary or appropriate. So that override to this policy is already in the law. What the committee report does, and I wish I had caught that in the subcommittee markup, I have to confess I didn't, which actually reduces that discretionary authority down to an agency level or department level. I think it would apply to DOE, Department of Commerce, NASA, any other Governmental entity.

In the GATT negotiations, and particularly in our relations with Europe, the whole issue of telecommunications, utilities, in particular telecommunications, has proven to be one of the stickiest and most difficult areas next to agriculture in terms of intransigence on the part of the Europeans in addressing this issue.

I won't go into some of the things we learned in terms of the problems with the unified Germany in terms of what American telecommunications industry and utilities industry has offered to do on a clearly competitive basis and an absolute stonewalling of the German Government to let them in.

I think what Mr. Torricelli is saying is don't give away the store at this point in time, and I simply want to remind members of the committee that the President does have the authority to authorize launch of a Government satellite on a foreign vehicle when he deems necessary.

The CHAIRMAN. We thank Mr. Henry for his comments. The Chair would like to indicate his own position on this, for what it's worth. Then we hope to move ahead quickly on this.

First of all, I do not disagree with the desirability of launching all U.S. Government payloads on American vehicles. I would be even willing to pay a little extra to do that, which I think Mr. Torricelli and others probably would agree with. The thing that leads me to take a position in opposition to this particular amendment has to do with the specific nature of the problem which involves the launch of EOS satellites which are not configured to fit any existing U.S. launch system. The peculiar aspects of the EOS program is that it basically is an international program. We are asking the Europeans and all of the other allies to contribute to the development of a strong resilient earth observing system as a part of the effort to control global warming. It is an international program and it should be an international program.

It seems to me that we compromise our position of seeking international collaboration and full partnership on a program like this when we say, we won't tolerate any of our allies, any of our cooperating partners participating in the launch of this EOS system. Even when we don't have a launch vehicle that is adequately sized to provide the most efficient launch in the United States. It is because of that international aspect of the particular problem here that I am constrained to speak in opposition of this particular amendment, although otherwise I would make considerable sacrifices in order to maintain this launch business for the United States.

I would be happy to yield to Mr. Torricelli.

Mr. TORRICELLI. Thank you, Mr. Chairman, for yielding.

The Chairman is indeed right that today with the current design of this program, there are some changes that would be required to use a U.S. capability. My point is that they are very modest. With physical changes at Vandenberg, modest changes could be used immediately to provide a U.S. capability from California. Indeed a Delta II could, in areas in the intermediate range, provide capabilities immediately.

And so, to my friend Mr. Hall's point, there is a net loss of U.S. business. McDonnell Douglas and General Dynamics can provide these services, much of these services, almost immediately. As the Chairman pointed out, I recognize that there is international participation in this program, but I also recognize that it is disproportionately an American program.

Some of you may believe that tomorrow, if General Dynamics or McDonnell Douglas go to the French Government to offer to launch a French Government satellite, they will be able to do business. You may believe that. I don't. They don't. This is not a free market. Our goal is to provide real competition and open market for all private launch services. But it is not the policy of the U.S. Government to do that for the U.S. Government. That is not our policy. You are absolutely destroying the negotiating position of the USTR if you do this today. What are they ever going to say in those negotiations when they won't even discuss them, and now there has been a unilateral concession. There will be changes—there will be some sacrifices, but overall the capability of the U.S. Government to do this when there is no choice—when there is not a U.S. company, has not been lost. As has already been suggested, the President has that authority today. What we simply don't want to do is to give that authority to every agency head throughout the United States Government to reach their own policy choice.

Let it remain where it belongs, with the President if it must be used. Thank you, Mr. Chairman. I promise I won't——

The CHAIRMAN. Let me yield to Mr. Packard first, Mr. Hall.

Mr. PACKARD. In the case of the Chairman's example of EOS and perhaps there are others that would fit into that category, the President now does have the authority to make the exception and allow it to be launched on foreign launch services.

What concerns me is that the European Space Agency has a very hard policy that will not permit them to send any of their government launch services on anything other than Arianespace. So they have locked up that corner of the marketplace. And they now want to enter our marketplace and have the options to not only compete but I think eventually control, or certainly to dominate, the launching of our Government payload. I think that the policy that we have had in the past is perhaps a good one. We do have the ability to make exceptions when exceptions are needed, but on the whole, I am not anxious to invite Ariane into our Government launch business. With that in mind, I tend to agree with Mr. Torricelli's amendment.

The CHAIRMAN. We thank the gentlemen.

Mr. Hall?

Mr. HALL. Will the gentlemen yield? I think of course Mr. Packard is correct in stating that the President does have that specific exemption, the right to that, and as is Mr. Henry. Actually, the national launch policy that was issued by the space council back last year sets up that restriction and we have actually tracked that and reiterated it.

Now, with the problem of allowing the use of foreign vehicles, that is clearly stated that that is only where there is no U.S. capability in existence. Something like this can drive U.S. technology. I think it did drive the technology. Sputnik alerted a young John F. Kennedy and the beep beep of that satellite alerted this whole country that we needed to do something technically and to take some steps that were taken.

The EOS satellite, Mr. Chairman, as you say is for everyone's benefit and everyone should have a part in assisting and participating in it. I think that the amendment would preclude the use of this language and I urge the defeat of the amendment.

The CHAIRMAN. We recognize the gentleman from Maryland.

Mr. MCMILLEN. I know we are beating this satellite to death, but it is an important issue and I appreciate the gentleman from New Jersey's interest in it.

I have a question that I would like to ask the gentleman. Is your concern have to do with kind of a definitional aspect as to who is going to certify whether there is adequacy of launch capabilities or not, and where that decision-making will reside? The way this language reads, I am not so sure who is going to make that certification, whether an adequate capability exists domestically or whether it does not exist. Your concern is that you don't have any problem with it being in the President's office; you have a problem with it being dissipated throughout the United States Government. Is that part of your concern?

Mr. TORRICELLI. My concern is first, what we do to our negotiating position. The second, my concern is that in the real marketplace for these services, you begin designing your satellite with a launch service or launch services in mind. Indeed if you opened this door, various agencies in the United States Government tomorrow can design satellites that indeed can only be served by foreign launch services. That can in fact happen, not because we don't have the technology or the capability, but by nature of their design, they will only fit a single system. Then you have established a permanent reliance.

Mr. MCMILLEN. Definitionally, if we pass this language that it is clear that the decision-making as to whether there is adequate launching capabilities may very well be in an agency department heads. That is how I read this.

Mr. TORRICELLI. That would be the net result of this. I would prefer that it remain with the President where it has always resided.

Mr. MCMILLEN. And I think that you make a good point in regard to that both from a leveraging standpoint and from a public policy standpoint.

Mr. TORRICELLI. Thank you.

The CHAIRMAN. The gentleman from Ohio.

Mr. TRAFICANT. I hate to oppose the Subcommittee Chairman, Mr. Hall, who has been one of my few supporters over the years.

The CHAIRMAN. Don't forget the Full Committee Chairman, too.

Mr. TRAFICANT. I would like to say this, if you allow Japan to make all the microchips, then America, at some particular point being able to be provided with all the microchips they need for their intensive electronics industry, they don't make any microchips. What Mr. Torricelli is doing, in my opinion, is absolutely needed, because the language as it is currently promulgated, opens the door. If in fact we do not have the capability to service the needs that we have in our space programs, and we are certainly the champions, then we continue a vacuum that may make us dependent in certain areas and we never develop that capability.

Second of all, we keep hearing all about this Sputnik. Let it be known that when our space program started we had our scientists and all these different agencies, never brought them together. Von Braun had a satellite ready to go without Government approval. I think it was less than 45 days after Sputnik was up there America was up there. It is not because we developed it in 45 days.

I have been consistent in my particular language. I think this fortification language by Mr. Torricelli speaks to policy. It may be more of an important amendment today, rather than just one of a dozen. I support it. I don't want to get the Chairman upset and the Subcommittee Chairman, because they have supported me in the past and they have shown good judgment in doing so.

The CHAIRMAN. I would really like to bring this to a vote, unless somebody has a really important speech to make on it.

Mr. HALL. Mr. Chairman, if I might just add that we really don't know where NASA nor Norm Augustine are on this. It was not spoken to and we simply wanted to open this possibility for the purposes of the EOS technical review. I think Mr. Torricelli has opened that for review and I think the committees reviewed it, and the Chairman of the subcommittee is not going to be upset either way the voting goes, just so long as I get to vote no.

Mr. MCMILLEN. Mr. Chairman.

The CHAIRMAN. The gentleman from Maryland.

Mr. MCMILLEN. Would the gentleman from New Jersey accept the language if the decision-making still resided solely in the President's hands?

Mr. TORRICELLI. Of course because that would be nothing more than the current policy. I doubt if those who wrote this, the question is probably best put to them, not to me, to do so simply giving the President the authority to authorize foreign launch services is a restatement of current law. The current law is fine with me, but I doubt if you'll find others would accept that.

Mr. MCMILLEN. I was posing that as a question to the subcommittee chairman and the Chairman. Where in the Chair's opinion does this authority vest under the language that is written? Who will make the decision whether there is adequate capability domestically or not? Under what office? I am curious because I think is the crux of the issue.

Mr. HALL. Mr. Chairman, I think we are making too big a to do over this amendment and taking too much time, but we might ask

the council if council has any advice on this, and then we can get underway.

Dr. SMITH. Thank you, Mr. Hall. The finding as it is does not change any existing authorities. The authority does lie with the President as written. It serves guidance in making a judgment on the exemption.

Mr. TORRICELLI. Mr. Chairman, with all due respect, that of course does not appear in the amendment. That is a judgment. The fact that we are debating who in fact would make this decision, where the authority rests may be some indication of the members that perhaps there may not have been sufficient consideration for this amendment. With that, I rest my case Mr. Chairman.

The CHAIRMAN. The Chair would like to put the question at this point. All those in favor of the amendment of the gentleman from New Jersey will signify by saying aye.

[Chorus of ayes.]

The CHAIRMAN. Opposed, no.

[Chorus of noes.]

The CHAIRMAN. The Chair is in doubt and would ask for a show of hands. Those in favor of Mr. Torricelli's amendment would raise their hand please and leave it up until counted.

[Show of hands.]

The CHAIRMAN. The ayes will put their hands down, and the noes will raise their hands.

[Show of hands.]

The CHAIRMAN. The clerk will report the vote.

The CLERK. Mr. Chairman, I have 12 ayes and 20 noes.

The CHAIRMAN. There being 12 ayes and 20 noes, the amendment of the gentleman from New Jersey is defeated.

The Chair will proceed to the next amendment, which is Amendment B offered by Mr. Bacchus and Mr. Lewis. Which of you would like to present your amendment?

Mr. BACCHUS. I will, Mr. Chairman.

The CHAIRMAN. Mr. Bacchus?

Mr. BACCHUS. Mr. Chairman, in other parts of this budget we have begun a program of research and development support for the commercial launch vehicle industry. I wholeheartedly agree that we must provide such assistance for our commercial space industry so that we can be competitive in the world marketplace. But equally vital to our competitiveness is the availability of first class launch sites and launch site support facilities.

Many of our current facilities were developed in the early 1950s and the 1960s, and in many cases equipment and facilities have not been replaced or approved since that time. I have visited outdated launch control centers with antiquated technology and with walls that are so frail that they must be protected with sandbags during launches. I wish that the other members of the committee could see what I have seen at some of these facilities. They would be embarrassed for our country.

Under current levels of international competition and given Federal control of necessary facilities, no single domestic launch operator can afford the entire investment needed for cost effective modernization of our launch infrastructure.

I believe the best way to do so, the best way to improve that infrastructure, is to encourage private public partnerships involving the Federal Government, State governments, and the private sector. We have encouraged that by law. This too is the goal of this amendment and others that Mr. Lewis and I are offering today in connection with it.

With its jurisdiction over the commercial space industry, which we have given it by law, I believe the Department of Transportation is the appropriate agency to oversee this modernization. I also believe this is an appropriate role for the Federal Government generally. The Federal Government has helped finance other modes of commerce such as seaports and airports. It is time we recognize that spaceports too are vital to our economy and they deserve the same support.

Most launch infrastructure currently is located at the Cape Canaveral Air Force Station in my district, and the State of Florida has taken the lead in addressing the modernization issue. But this amendment also would help other innovative sites, such as Virginia, Texas, California and Hawaii, that are also attempting to encourage development of the commercial space industry.

Specifically, this amendment would add a finding. In addition there are two related amendments, one that would add some language that would help us get money later this year from the transportation budget, and another that would add some report language.

[The amendment offered by Messrs. Bacchus and Lewis follows:]

b)

AMENDMENT TO COMMITTEE PRINT
OFFERED BY MR. BACCHUS AND MR. LEWIS

On page 3, after line 15, insert the following and renumber the succeeding paragraphs:

(9) the strengthening and expansion of the Nation's space transportation infrastructure, including the enhancement of launch sites and launch site support facilities, is essential to support the full range of the Nation's space-related activities;

Mr. HALL. Will the gentleman yield?

Mr. BACCHUS. Yes, Mr. Chairman.

Mr. HALL. I think it is a very thoughtful addition and certainly in support of a full range of the Nation's space related activities. It simply expresses a finding regarding the policy for infrastructure for later work, does it not?

Mr. BACCHUS. That's correct, Mr. Chairman.

Mr. SENSENBRENNER. Will the gentleman yield?

Mr. BACCHUS. Yes.

Mr. SENSENBRENNER. I have no problems with this amendment because I do think that the goal is a very admirable one. However, I am afraid the two gentlemen from Florida are going to be using this as a boot strap for their next amendment which is labeled J in the package, that authorizes such additional sums as may be necessary to insure the resiliency of the Nation's space infrastructure.

After all the good work we have done to try to put this thing within a reasonable financial means, that seems to be somewhat of an open-ended hemorrhage. Please tell me it isn't so.

Mr. BACCHUS. Reclaiming my time, as I acknowledged in my remarks, that is precisely our intention, to boot strap into something that we could do through the transportation budget, and not through the NASA budget. But I don't think that is in any way a parochial concern. The facilities that I mentioned are federal facilities at a federal installation that are used by this entire Nation, and the undertaking is entirely worthwhile.

Moreover, my assumption is that whatever we are able to work out with those who are in charge of transportation dollars, they will make certain that it is done fully within the realm of the budget agreement.

The CHAIRMAN. Mr. Lewis is recognized.

Mr. LEWIS. Mr. Chairman, in support of what the gentleman from Florida said, we would like to point out that this is filling in the blanks of our commercial facilities if we are going to have a competitive program from the commercial viewpoint as well as from the NASA viewpoint. It is necessary to have the proper launch facilities available in order to meet the needs of a commercial program, and that is essentially what the gentleman's amendment at this point is doing.

The CHAIRMAN. The gentleman from Wisconsin.

Mr. SENSENBRENNER. Mr. Chairman, I move to strike the last word.

The CHAIRMAN. The gentleman is recognized.

Mr. SENSENBRENNER. Mr. Chairman, I would like to draw the attention of the members of the committee to Amendment J which our two friends from Florida are going to be introducing at the proper time later on in the consideration.

We have in the bill that has been offered a specific authorization of $5,104,000 for infrastructure improvements for fiscal year 1992. The next amendment that the two gentlemen from Florida are proposing is proposing to add the following language, "in such additional sums as may be necessary to insure the resiliency of the Nation's space infrastructure." If there ever was a blank check, I've never seen one that is quite that big. My concern is that every pretense that we make about bringing the budget down to size and to

making this committee players in how we set budget priorities will go out the window of the second amendment is adopted.

Furthermore, by saying that we are going to authorize a sum sufficient to authorization, we take away our budget oversight responsibilities forever, and simply allow anybody that wants to spend money on improving space infrastructure anywhere in the country to say that they have already gotten the authority from Congress of the United States.

I want to put this on record because I don't think we should be using the first amendment and changing the findings as a boot strap for the second. Vote however you want on this one, but I really think that if we want to be serious about maintaining any kind of budget discipline, as well as reserving ourself the prerogative of being able to review where this money is spent some time in the future before it is spent, we ought to vote down the second amendment.

Mr. BACCHUS. Will the gentleman yield?

Mr. SENSENBRENNER. I would be happy to yield.

Mr. BACCHUS. With all due respect, I believe the gentleman overstates the case. I really don't think that this would bankrupt the budget agreement. This language is fairly open language. However, we would only need a few million dollars to do this and it would not be our intention to try to float a tax increase in order to do it

Mr. SENSENBRENNER. Well, reclaiming my time, if you only need a few million dollars to do it, then why don't you say how many a few million is, rather than saying, "and such additional sums as may be necessary to ensure the resiliency of the Nation's space infrastructure." That kind of boggles the mind and the bureaucrats that like to spend money always add a few zeros when they get this kind of an open-ended authorization.

Mr. HALL. Would the gentleman yield?

Mr. SENSENBRENNER. I yield to the gentleman from Texas.

Mr. HALL. As the gentleman knows, we worked very closely in the subcommittee and I think the gentleman from Florida had an amendment there that requested a specific amount and after we discussed it, he pulled it down. I've read the amendment, J, and it is not specific to spaceport Florida, first. We agree to that, don't we?

Mr. SENSENBRENNER. Yes we do. That means that everybody else can cut themselves into the gravy as well without us even approving it.

Mr. HALL. Well, but this is, and you may be correct and I am trying to think the thing through with you as I talk here, but this seems to be just general authorizing language and is at most a ticket to the Appropriations Committee to request money to be earmarked, that they've got to get the money and the money does not come from NASA, it comes from where, transportation?

Mr. SENSENBRENNER. Reclaiming my time, then why don't we have an amendment here that just authorizes such sums as may be necessary to build the space station three designs ago, which is what we were all interested in before the Appropriations Committee went and noodled it all up. These open-ended authorizations are just a flat out abdication of this committee's responsibility to set priorities and to use our expertise. Again, perhaps I am direct-

ing my fire at the wrong target because this amendment does not contain this authorization, but I sure don't want the rest of the committee to get backed into a corner and have the two gentlemen from Florida say, well you voted for Amendment B, so now you've got to vote for Amendment J. One should not follow the other.

Mr. VOLKMER. Mr. Chairman?

The CHAIRMAN. Mr. Volkmer.

Mr. VOLKMER. I would like to ask staff a couple questions in regard to the J Amendment since we are on that, and I think that probably is the most important part of it.

In the bill before us, the funds of $5,104,000 on page 19 is being authorized for the Secretary of Transportation. Is that not correct?

Mr. BACCHUS. Yes, Mr. Volkmer.

Mr. VOLKMER. Now those funds will come out of which, NASA's funds?

Mr. BACCHUS. No, those are authorized directly to the Office of Secretary of Transportation and will be appropriated to that office, and this is for the operation of the Office of Commercial Space Transportation.

Mr. VOLKMER. Right. Now, as to when we get to the budget, do those come out of their area, or out of transportation?

Mr. BACCHUS. No, Mr. Volkmer, it comes out of transportation.

Mr. VOLKMER. Those will come out of transportation?

Mr. BACCHUS. Yes, sir.

Mr. VOLKMER. And the amendment then, applying to the same thing, would come out of transportation.

Mr. BACCHUS. That's correct.

Mr. VOLKMER And would not come out of NASA's budget or a space budget at all. Correct?

Mr. BACCHUS. That's correct.

Mr. VOLKMER. And all the amendment is then saying is basically that the Appropriations Committee and the transportation budget wants to appropriate funds for a commercial launch site facilities, etc. this authorizes them to do so.

Mr. BACCHUS. This would provide a general authorization for that kind of activity.

Mr. VOLKMER. Thank you, Mr. Chairman.

Mr. HALL. Would the gentleman yield?

Mr. VOLKMER. Yes.

Mr HALL. Perhaps there is a way that the two gentlemen from Florida can work up some addition to Amendment J that would specify and clarify the objection Mr. Sensenbrenner has, provided however typed addition to the amendment.

The CHAIRMAN. Any additional members desire to speak on this matter? We've been talking to Amendment J. Actually Amendment B, as I understand it, is not controversial, and I wish to put the question on Amendment B. All those in favor of Amendment B will signify by saying aye.

[Chorus of ayes.]

The CHAIRMAN. Opposed, no.

[No response.]

The CHAIRMAN. In the opinion of the chair, the ayes have it and the amendment is adopted.

We will proceed to Amendment C, offered by Mr. Walker.

Mr. WALKER. Mr. Chairman, this is a space station amendment, and what it does it deletes the requirement that $128 million be withheld until the committee receives a National Research Council report on the space station restructuring. And instead what I would do is replace that with a request for such a report by January 31, 1992. Let me tell you why I think this amendment is important in that regard.

Any money that is withheld by us will appear to the appropriators to be money that they can do away with. I think it is extremely important that we send a message to the appropriators within these lines that we are drawing, that the absolute minimum that we want for space station is the total amount requested by the President and the total amount, the $2.18 or $2.128 billion which is in the budget. That is the absolute minimum that we will accept for space station.

Also, it seems to me that it will speed up the actual report that we are looking to get. It will be helpful for us to have this report by the time we begin the authorization process next year. Without a deadline, we will find ourselves in a situation that we face this year as we attempted to draft legislation while the restructuring report was being finalized. So, I think that both in terms of the report and in terms of what we are attempting to achieve in terms of space station funding, this amendment makes some sense.

Furthermore, there is another part to this amendment that the members need to focus on. The amendment also ties the authorization for space station to the issuance of a NASA report on solar dynamic power and on the agency's plan for spending the $10 million appropriated in fiscal 1991 in the appropriations bill. NASA has had $10 million that they have not done anything with. I think it is important that they move ahead and give us some accounting for the $10 million that was decided for solar dynamic. The space station restructuring has deleted the requirement for solar dynamic through the permanently manned capability stage. It is clear though that solar dynamic is the preferred method of power generation in the long run, and it makes sense for the agency to continue its work in this area.

Let me point out again, this is money that is already there. I am not putting new money in. This is money that has already been appropriated. It is in NASA, we simply don't have a good accounting for it at this point and so what this amendment asks for is an accounting for that money to assure that the solar dynamic option is being actively explored.

[The amendment offered by Mr. Walker follows:]

(short)

c)

AMENDMENT TO THE COMMITTEE PRINT

OFFERED BY MR. WALKER

Page 5, lines 11 through 22, amend subparagraph (A) to read as follows:

(A) United States International Space Station Freedom, $2,028,900,000 for fiscal year 1992, of which $25,000,000 shall be for the development of an Assured Crew Return Vehicle. The Administrator is directed to contract with the Aeronautics and Space Engineering Board of the National Research Council to conduct an independent engineering review of the Space Station restructuring and submit a report to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate no later than January 31, 1992. None of the funds authorized by this subparagraph shall be made available until —

(i) the report required under section 103(a)(1)(A)(ii) of the National Aeronautics and Space Administration Authorization Act, Fiscal Year 1991; and

(ii) a report detailing expenditures made, and a plan for further expenditures, from the $10,000,000 appropriated for solar dynamic power research under the Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1991, are submitted to the Committee on Science, Space, and Technology of the House of Representatives and the Committee Commerce, Science, and Transportation of the Senate.

The CHAIRMAN. Does any other member desire to be heard on this amendment?

Mr. VOLKMER. Mr. Chairman.

The CHAIRMAN. Mr. Volkmer.

Mr. VOLKMER. The only part that I want to discuss a little bit is that the hearing we had back a week or so ago, the subcommittee on the space station restructuring, it is my understanding, and perhaps the staff can correct me if my understanding is wrong, because I asked this specific question, and it is my understanding that they have now decided that they no longer need, because of restructuring, the solar dynamics, and they have no inclination to go forward with any further research on it or plans to use it at all. Therefore, it is my understand that those funds would either lapse or be reprogrammed somewhere else in the space station, but not used for solar dynamics.

Mr. WALKER. NASA, of course, has never been particularly enthusiastic about solar dynamic because it has up-front costs connected with it. But the fact is that the overall operating costs are much lower, so one of the reasons why solar dynamic has been pursued is because we, in this committee, have insisted on it, and the appropriators have insisted upon it, and the appropriators have insisted upon it to the point of putting $10 million in last year's bill which I'm sure NASA might want to reprogram, but the question is whether or not we are going to permit them to go ahead. The life cycle savings of going the solar dynamic option are about three to six billion dollars. That is not small change and it is something that we have consistently decided is within the national interest to be pursuing. So, all this amendment does is reiterates our belief that that is an option that ought not be cancelled by NASA at this point.

Mr. VOLKMER. Mr. Chairman, reclaiming my time, I just can't envision with the cost problems that we are having now on the station and whether or not we are going to find, through appropriations and through this budget, the money to continue on, to then say we will take money for the future where solar dynamics is not needed, because the amount of electrical energy that is going to be needed by the space station is going to be fulfilled with the present raise. I just don't understand the idea of pushing NASA to do something that means that they may have to take money away from something else in order to do that, when it is no longer necessary.

Mr. WALKER. If the gentleman would yield. Again, I might point out to the gentleman, this is money that was already appropriated. It is not taking money away, and it is not putting money into this particular authorization or anything. It simply says to NASA you had $10 million allocated for this, we would like to know what you did in terms of utilizing that $10 million toward either proving or disproving the solar dynamic option.

Mr. VOLKMER. I just feel that you already have the answer. You do what you want, but I think you already have the answer.

The CHAIRMAN. Mr. Hall?

Mr. HALL. To strike the last word, let me just set out here, we provided $1.9 billion with no strings attached, but withheld $128 million until NASA submits us a report on the restructuring of the

space station. If the gentleman from California remembers, that is what we did in subcommittee. The gentleman from Pennsylvania, Mr. Walker, knows that I admire and respect him, and even emulate him on many conservative thrusts. And I tore a page out of your book Mr. Walker when I withheld that money until we got that report. I learned that from you. But your amendment simply releases this money that we are holding.

Mr. WALKER. If the gentleman would yield.

Mr. HALL. Yes I do yield.

Mr. WALKER. I do in fact take the hold off because I am afraid that the appropriators would interpret that as withholding money that I think the committee intends to spend. They will take that as meaning that is $128 million which isn't really necessary in the upcoming year. But I do demand that the report be done and in fact I set in the amendment a deadline for the report to be done by January of 1992.

Mr. HALL. You know, last year we set aside $10 million for solar dynamic power development, and this asks for some kind of a report on that, and while I only withheld, the subcommittee withheld $128 million which is just a small amount of the overall appropriation, the last sentence in your amendment says none of the funds authorized by this subparagraph shall be made available until you get those reports. Now, we held a poultry $128 million out until we got a report on something from this subcommittee and this committee and this Nation waits for breathlessly is the restructuring of the space station. Where is the money going to be and how is it going to be, what configuration is it going to be? We wanted that report. Your amendment would release that money, and yet it would hold up all of the money if you didn't get the report that you asked for.

Mr. WALKER. First of all, let me say to the gentleman that the report to which you refer is due May 1st. I am hopeful that what the committee will do is send a signal that we want that report up here by the May 1st deadline date which is next week. So, they are not yet done. We can delete that whole section if, in fact, NASA comes forward with the report and so what we are attempting to do is tell them, in that case, that the deadline that we set last year is real. I would say to the gentleman that that is in support of my belief that going the route of setting a real mandate for NASA should, in fact, be pursued by the committee. So, I think he makes a valid point. Part of this is an attempt by me to say to NASA, we want that May 1st report.

Secondly, it seems to me that by setting a date deadline on the other point, we simply make a stronger case to the appropriators.

Mr. HALL. In answer to that, I want you to get your report, I will help you get your report. I will vote with you to get your report. Just don't simply release $128 million that we are holding to get our report.

Mr. WALKER. I am perfectly willing to strike the language that the gentleman objects to in the second section, but I think that since what we are attempting to do is make certain the appropriators understand what this committee is up to, we don't want to send the wrong signals either. My concern is that based upon past experience, if we tell them this is $128 million we think can be

withheld, they will interpret that as meaning it is $128 million more than they have to pay with. That is a five percent cut in space station that we don't think is necessary to do. That is the main thing that I am trying to avoid here.

Mr. HALL. It will be a cut unless they give us the report that we are entitled to. I just have the subcommittee's position to protect and the minority leader's position to respect. I am willing to vote.

The CHAIRMAN. Any further debate on this amendment?

[No response.]

The CHAIRMAN. If not, the Chair will put the question. All those in favor of Amendment C offered by Mr. Walker will indicate by saying aye.

[Chorus of ayes.]

The CHAIRMAN. Opposed, no.

[Chorus of noes.]

The CHAIRMAN. In the opinion of the chair, the noes have it and the amendment is defeated.

Mr. Walker has Amendment D also.

Mr. WALKER. Mr. Chairman, this amendment makes some adjustments in some of the bill language with regard to space transportation capability and development. In that particular line, the subcommittee has earmarked $40 million for the development of the space transportation main engine, and $10 million for studies to define the roles, missions and configurations of a new launch system.

My amendment is the same amount of money, but what it does it allocates $30 million for generic propulsion technologies, and $20 million for the development of other launch technologies, including single-saged orbit vehicles.

Now, the reason why I think we ought to do this is there has been no mission identified for the new launch system. So therefore, it seems to me that it makes sense to devote our resources of developing technologies that will be useful in a broad range of vehicles, when our launch needs dictate what we should be doing in the next couple of years and when the launch needs become clearer.

This amendment does not preclude NASA from doing STME work, but it simply gives the agency leeway to explore other technologies as well.

Let me single out one of those. That is the single-staged orbit technology. This is something that SDI has been working on that I think has massive civilian applications to it. The work we have done on NASP has allowed us to develop new materials that can now be utilized in single-staged orbit. It seems to me that it makes sense then for us to have a foot in the door on that kind of technology.

Under my amendment, we would have the opportunity to move in that direction towards some new technologies and some new capabilities with regard to propulsion, rather than being limited in the way that I read the subcommittee language as limiting us.

So, the money is the same. It simply gives NASA a little more latitude to move toward more generic kinds of technologies which I think really improve our ability to respond to space transportation, rather than being very specific toward a system that may or may not have a mission.

[The amendment offered by Mr. Walker follows:]

(cont)

d)

AMENDMENT TO THE COMMITTEE PRINT
OFFERED BY MR. WALKER

On page 5, beginning on line 23, strike all through page 6, line 5 and insert in lieu thereof the following new subparagraph:

(B) Space transportation capability and development, $679,800,000 for fiscal year 1992, $799,800,000 for fiscal year 1993, and $847,400,000 for fiscal year 1994. Of such amounts authorized for fiscal year 1992, $30,000,000 shall be made available for propulsion technology development and $20,000,000 shall be made available for technology development of other launch technologies, including single stage to orbit vehicles.

The CHAIRMAN. The Chair would like to indicate that he has examined this amendment and that if he has Mr. Walker's assurance that we would not be precluded from spending a reasonable amount of this money on the main engine development, that he would be willing to support this amendment.

Mr. WALKER. As I stated in my opening remarks, no. It is absolutely clear to me that this does permit NASA to move ahead with main engines. It also gives them the opportunity though to do other work as well, but it certainly would allow them to continue to work on advanced main engines.

The CHAIRMAN. The Chair would ask the committee to join in approving this amendment.

Mr. ROHRABACHER. I would like to submit a statement for the record in strong support of Mr. Walker's amendment.

[The prepared statement of Mr. Rohrabacher follows:]

Hon. Dana Rohrabacher
Statement in support of Walker Amendment
re: Launch Systems research
April 24, 1991

* MR. CHAIRMAN, I rise in strong support of Mr. Walker's amendment.

Mr. Walker's amendment will help to direct NASA to conduct research on innovative and imaginative technologies that will benefit this nation's commercial launch services industry.

>Page 1

More importantly though, this amendment will direct NASA to look at a fresh approach to putting payloads into orbit -- that of going to orbit with a single stage.

Mr. Chairman, for more than thirty years we have put payloads into orbit atop what one noted space expert has called "disintegrating totem poles." With each launch, rockets shed expensive stages

>Page 2

and throw them away. Even the Space Shuttle discards a THIRTY MILLION DOLLAR External Tank with each launch.

The time is long overdue for this nation to look at new approaches to procuring, building, and flying what we put into Low Earth Orbit. My amendment, in the Space Subcommittee, amending the very same section Mr. Walker now seeks to change, was aimed at

> Page 3

trying to inject just such change.

Mr. Walker's amendment offers such change. It charges NASA with looking at ways of doing things in space that offer the possibility through new technological approaches of radically changing the way we do business in space.

After all, Mr. Chairman, the mission of developing radical new technologies IS one

> Page 4

of NASA's core reasons for existence.

I strongly support this amendment and I urge its adoption.

> Page 'P'

Hon. Dana Rohrabacher

> Page 5

The CHAIRMAN. The Chair will, of course, allow that statement for the record. Does anyone else wish to make a comment or submit a record?

[No response.]

The CHAIRMAN. If not, the Chair will put the question. All those in favor of Mr. Walker's amendment signify by saying aye.

[Chorus of ayes.]

The CHAIRMAN. Opposed, no.

[No response.]

The CHAIRMAN. The ayes have it. The amendment is agreed to. Mr. Henry has Amendment E.

Mr. HENRY. Thank you, Mr. Chairman. If it is in order now, I would ask unanimous consent to combine it with Amendment R and kill two birds with one stone because Amendment R simply conforms report language to Amendment E. So if Amendment E passes, R would be necessary. If Amendment E doesn't, Amendment R wouldn't be. Would that be in order?

The CHAIRMAN. That would be in order, and without objection, the gentleman may present them en bloc.

Mr. HENRY. Thank you, Mr. Chairman. In the Space Subcommittee, we had some discussion relative to the subcommittee's recommendation that funding levels for the x-ray observatory be reduced. The recommendation was based upon language which was in the current report language on an assumption that there was a problem and delay in certifying the mirrors. That is obviously a very serious issue, given our past experience with Hubble.

Very quickly, and I think in two minutes I can explain where we are and what has happened for members who are interested. We have the Hubble telescope up there. We know what its problems have been. Hubble telescope is basically a light refraction telescope. We have the gamma ray telescope up, and it is a gamma ray refraction, if that word is correct. The x-ray telescope will be the third to be launched in about eight or nine years, if all goes according to schedule, and then there is a fourth to follow which will be an infrared telescope—four different types of space astronomical instruments. Two are up. The x-ray is the next in line.

There was some question as to whether or not the assumptions upon which the subcommittee had been operating that there were, in fact, problems or delays in certifying the mirrors if they were in fact correct. The subcommittee markup, the independent contractors who are overseeing the work, who are the hired evaluators, a NASA staff and the contractors have all met and what this simply does is that they have come to the conclusion that such a delay does not exist, and in fact to stretch out the funding would first of all, not only add to the cost, because we would be imposing delays on the project, but might, in fact, undermine quality assurance because of the trainers and the evaluators are in fact trained and ready to go on the next instrument. They basically have to start over again at a later date. So, this takes $12 million from the fourth telescope, the next in line telescope, a new account, transfers it back into the on-line telescope, if that makes sense, and restores out-year funding. I believe it has been discussed with ranking members on both sides, and I do not believe there is a problem.

[The amendment offered by Mr. Henry follows:]

(draft)

e)

Amendment to the Committee Print

Offered by Mr. Henry

Page 6, line 10, following "Station", strike "$1,241,400,000 for fiscal year 1993, and $1,248,500,000 for fiscal year 1994" and insert in lieu thereof "$1,321,400,000 for fiscal year 1993 and $1,308,500,000 for fiscal year 1994"

The CHAIRMAN. The Chair understands that there is not a problem, but he would ask the subcommittee chairman to indicate whether this is a satisfactory amendment.

Mr. HALL. Mr. Chairman, just for the record, the subcommittee, we took $50 million out and this still gave the contractors a $50 million increase. We took about half of the increase of the $110 million that they had asked for. What this gentleman is doing is partially restoring $12 million, and correct me if I am incorrect, of the $50 million we took out. This gives $88 million of the $110 million increase that was requested. So, actually where NASA requested $211 million for fiscal year 1992, we cut this by $50 million and he only wants to cut it by $38 million. Is that generally basically what you've done?

Mr. HENRY. That is correct. Mr. Chairman if I may just respond. We believe there is enough by way of contingency funds in the account so there will not be a slowdown in the project. Obviously we don't want to get ahead of quality assurance issues. On the other hand, we don't want to impose a needless slowdown. We think we have found the right number.

Mr. HALL. I wish you would have kept a report language on our reasons on the x-ray astrophysics facility. The reasons for the cuts, I do believe the amendment is fair and its budget neutral because you've taken the $12 million from two new-starts somewhere. I don't know exactly where they are. I have no objection to the amendment.

The CHAIRMAN. Any other comments with regard to the amendment? Hearing none, the Chair will put the question. All those in favor of the amendment will signify by saying aye.

[Chorus of ayes.]

The CHAIRMAN. Opposed, no.

[No response.]

The CHAIRMAN. The ayes have it. The amendment is agreed to.

The Chair will go to Amendment F, which is the chair's amendment.

Mr. HALL. The subcommittee chairman has absolutely no objection.

The CHAIRMAN. Let me offer just a brief explanation. What we are trying to do is to ensure the timely development of LANDSAT 7 as a follow-on to LANDSAT 6 which is to be launched in another year or two. In order to do that, we are seeking to put $5 million from NASA's budget, and we will have to ask for corresponding amounts from the NOAA budget and from the DOD budget, who are all jointly responsible for this program, to allow the early procurement of long lead time items in order to keep LANDSAT 7 on a schedule which will maintain the continuity of data for the LANDSAT program.

We think this is a reasonable way to do that and we urge the adoption of the amendment.

[The amendment offered by Mr. Brown follows:]

(about)

BROWCA043

8)

AMENDMENT TO THE COMMITTEE PRINT
OFFERED BY MR. BROWN OF CALIFORNIA

Page 6, lines 18 through 24, amend subparagraph (F) to read as follows:

(F) Earth science and applications--

(i) $725,600,000 for fiscal year 1992, of which--

(I) $5,000,000 shall be made available only for the purchase of Landsat data for global change research;

(II) $5,000,000 shall be made available for the purchase of long-lead parts for a follow-on to Landsat 6; and

(III) $1,000,000 shall be made available for remote sensing data conversion; and

(ii) $830,000,000 for fiscal year 1993; and

(iii) $950,500,000 for fiscal year 1994.

Mr. HALL. Will the gentleman yield?

The CHAIRMAN. I would be happy to yield to the gentleman.

Mr. HALL. This simply sets aside $5 million for your long lead parts and its budget neutral as I understand, and simply tells NASA to look ahead.

The CHAIRMAN. That is correct. The gentleman from Maryland.

Mr. MCMILLEN. Mr. Chairman, I would just like to add to what has been said. This is an important amendment to keep us on the pathway towards future LANDSAT missions. The remote sensing work is very, very important with regards to the global warming research that is being done, and I commend you for it.

The CHAIRMAN. If there is no further discussion, the Chair will put the question. All those in favor signify by saying aye.

[Chorus of ayes.]

The CHAIRMAN. Opposed, no.

[No response.]

The CHAIRMAN. The ayes have it and the amendment is adopted.

Amendment G by Mr. Bacchus.

Mr. BACCHUS. Mr. Chairman, I question first, does the passage of Mr. Walker's earlier amendment in any way supersede this one?

The CHAIRMAN. The answer to that is no.

Mr. BACCHUS. Thank you, Mr. Chairman. Mr. Chairman, in the Space Subcommittee we authorized a new program to develop and expand technologies that would be of value to the commercial launch vehicle industry in our country. This program is a long overdue recognition that we must provide such support for this industry to be competitive in the world marketplace.

NASA's research and development initiatives long have been a tremendous value to commercial aircraft industry. If we are only half as successful in this new effort, we still will have provided a significant boost for our commercial space industries. My amendment would transfer this program from NASA's Office of Aeronautics, Exploration and Technology, to the Office of Space Flight which I believe will be better able to carry out this program. The Office of Space Flight has managed NASA's expendable launch vehicle program since the agency's inception and currently oversees NASA's purchase of commercial launch services.

For this reason, I believe it is in a better position to understand the needs of the commercial launch industry and to help this industry realize its full potential. I might add that I am pleased that this amendment has the strong support of the chairman and ask for support from the rest of the committee.

[The amendment offered by Mr. Bacchus follows:]

(adopted)

9

AMENDMENT TO COMMITTEE PRINT
OFFERED BY MR. BACCHUS

On page 7, line 22 through page 8, line 5, amend subparagraph (N) to read as follows:

(N) Space research and technology, $314,800,000 for fiscal year 1992, $321,700,000 for fiscal year 1993, and $317,200,000 for fiscal year 1994.

On page 9, lines 7 through 9, amend subparagraph (C) to read as follows:

(C) Launch Services, $315,900,000 for fiscal year 1992, $289,00,000 for fiscal year 1993, and $359,800,000 for fiscal year 1994. Of such amounts, $10,000,000 in fiscal year 1992, $30,000,000 in fiscal year 1993, and $50,000,000 in fiscal year 1994 shall be made available for carrying out a program of component technology development, validation, and demonstration directed at commercial launch vehicle competitiveness.

Mr. WALKER. Would the gentleman yield?

Mr. BACCHUS. Yes I will.

Mr. WALKER. This amendment is very complimentary to the one that was passed just a few minutes ago and I think does enhance our ability to get good research into the commercial development portion of the space industry. I congratulate the gentleman for his amendment.

Mr. BACCHUS. Thank you, Mr. Walker.

The CHAIRMAN. Any further comments? Mr. Hall.

Mr. HALL. I would like to make an inquiry of Mr. Bacchus. Are you on Amendment G?

Mr. BACCHUS. Yes, sir, I am.

Mr. HALL. On page 7, line 22? Let me be more specific. Is this simply the amendment that transfers a program from one entity that didn't want it to another one that did?

Mr. BACCHUS. Yes, sir.

Mr. HALL. Okay, thank you.

The CHAIRMAN. If there is no further discussion, the Chair will put the question. All those in favor of the amendment by Mr. Bacchus will vote aye.

[Chorus of ayes.]

The CHAIRMAN. Opposed, no.

[No response.]

The CHAIRMAN. The ayes have it and the amendment is agreed to.

Amendment H is also by Mr. Bacchus.

Mr. BACCHUS. Thank you, Mr. Chairman. I would like to begin by asking for unanimous consent to offer a substitute amendment.

Mr. SENSENBRENNER. Reserving the right to object, let's find out what it is.

The CHAIRMAN. The gentleman from Wisconsin reserves the right to object. Would the gentleman from Florida proceed to present his substitute and then ask unanimous consent.

Mr. BACCHUS. Yes, sir. We are distributing it now. Let me begin by explaining the differences between the original amendment and this substitute. The original amendment would have earmarked certain monies within the Space, Research and Technology budget to allow continued work on the flight telerobotic servicer. At the urging of several of my colleagues, I have instead offered a substitute amendment which would merely restore the monies that were deleted at the subcommittee level to pay for the continued development of the flight telerobotic servicer.

I might say that in general, I am very supportive of the approach we have taken at the subcommittee level at trying to establish priorities and trying to get our foot in the door into the appropriations process. Not shoot for the moon and not get there as Mr. Sensenbrenner put it earlier so eloquently. I appreciate the chairman's concern for trying to identify offsets to any increases that are proposed. But I am very concerned about our ability to use robotics and continued efforts to explore space. I am concerned about the investment of $200 million that we have already made in the flight telerobotic servicer. I am concerned about the possibility that our colleagues in Space Station Freedom will profit from the use of it to develop their robotics technology, and yet we will not.

I notice the Council on Competitiveness report came out last week with a very poor grade for our ability to stay on the cutting edge, the competing edge, as a Nation. One of the things that they highlighted was our lack of effort and our lack of advancement in robotics. I believe we need to restore these monies. I believe it is a good program that must be continued.

[The amendment offered by Mr. Bacchus follows:]

School

Substitute offered

SUBSTITUTE AMENDMENT TO COMMITTEE PRINT
OFFERED BY MR. BACCHUS

On page 7, line 22 through page 8, line 5 amend subparagraph (N) to read as follows:

(N) Space Research and Technology, $354,800,000 for fiscal year 1992, $321,700,000 for fiscal year 1993, and $317,200,000 for fiscal year 1994.

The CHAIRMAN. The gentleman from Wisconsin?

Mr. SENSENBRENNER. Mr. Chairman, I oppose both the substitute as well as the original amendment that was offered by the gentleman from Florida. The substitute is a straight $55 million add-on.

Mr. BACCHUS. But it is not an open check.

Mr. SENSENBRENNER. No, it is not an open check. The gentleman from Florida is learning, but it is still a straight $55 million add-on. A bounced check perhaps. That flies directly in the face of what the chairman said were the parameters, and that was that we ought to be funding our amendments here so that we are not simply adding to the cost of the total bill and thus making us less relevant in terms of participants.

So, I believe the fact that there is not an offset in the amendment in the nature of a substitute, that this committee ought to vote it down merely on fiscal grounds, if on no other grounds.

The original amendment age, which the gentleman from Florida has introduced, does provide the offset of $55 million out of other types of robotic programs. The question there is whether we should earmark the money for the flight telerobotic servicer or not. I think given the history of the flight telerobotic servicer, the answer is no and that amendment should be defeated as well. The flight telerobotic servicer has been something that has been kicking around as long as the station has been there. NASA really wanted to try to de-fund it two years ago, or at least take it off the capital budget of the space station by trying to privatize the flight telerobotic servicer. That didn't work because the only client for the use of the FTS would end up being NASA itself, and as a result, the taxpayers would end up paying two or three times in the long run by transferring the cost of the FTS from a capital expense in the construction of the space station, to an operational expense. That did not fly as well.

When the station was redesigned, pursuant to the directions of the Appropriations Committee last year, the FTS was x'ed out. I think that to the Appropriations Committee, gave the hint and NASA took it that spending more money on the FTS would be throwing good money after bad, and that the FTS was really not a necessary ingredient, particularly for the down-scope space station that we are in the process of funding in this bill.

So, I would hope that we would maintain our fiscal discipline in voting against the amendment in a nature of a substitute. I would hope that we would deal with the issue on the merits that the FTS is not necessary for the space station, particularly in its down-scope to state that was presented to the subcommittee and the Congress last month, and that we would vote down the base amendment as well. I yield back the balance of my time.

The CHAIRMAN. The Chair would like to inquire again if there would be any objection to merely considering the substitute offered by Mr. Bacchus. Without objection, the substitute is before us which does not seek to offset the $55 million. So, it is a straight add-on. Is there further discussion? Mr. Walker?

Mr. WALKER. Mr. Chairman, a few moments ago when I was talking solar dynamic, the argument was made that this is something that the station does not need, and so therefore the money ought to be saved. I would submit that if that argument did pre-

vail, which it did in earlier times, it should also prevail here because there is not a specific need for the telerobotic servicer and it also means that you would have to fly an additional shuttle flight in order to do this. So, you are talking about a significant cost in flights at some point in the future. So, I would suggest also that the gentleman's amendment in this case be turned down.

The CHAIRMAN. The gentleman from Texas?

Mr. HALL. I would like to say a few words in favor of the author, but against his amendment.

The CHAIRMAN. The Chair would be glad to entertain that.

Mr. HALL. Actually, his substitute softens it a little bit, but it doesn't erase the fact that this amendment authorizes $55 million for the flight services where the subcommittee took out $40 million. This fully funds the item and the gentleman does such a good job of representing his district and his people and setting forth his position on these things. It is tough to oppose him and it is also tough to oppose it, though I do oppose it, but it is tough to because the contractor here has done a very good job in getting control over this program in the last couple of months. I commend their management and if the money is provided, they are certainly capable of a very good flight test.

But under the budget circumstances, we are required to look, I think, only at the funding of the very highest priority which this is not by anybody's testimony here. It would be nice to have these flights. They provide some good data, but there is no clear application, as the gentleman from Pennsylvania has said, for this piece of hardware. If authorized, it is my recollection that NASA testified here that they wouldn't use it. So, it seems to me, and also if we test the flight telerobotics, if we test this service, we will have to fly another additional shuttle at a cost of about $300 million.

Really, this has really been set forth by almost everybody that has testified that there was no technical need for it and technically there is no need to test it, so say most of those and the Canadians have made that expression as have others. I reluctantly oppose this basically because of the budget constraints and because it simply won't be used.

The CHAIRMAN. I think the gentlemen and I would like to add my own praise to Mr. Bacchus for his commitment, both to the NASA programs in general, and to robotics in particular which I think may well be critical to the future of the space program. However, I come down on the same side as the chairman and the ranking member of the full committee. This is not something that is essential at the present. I therefore oppose the amendment.

Mr. BACCHUS. Mr. Chairman?

The CHAIRMAN. Mr. Bacchus.

Mr. BACCHUS. I sense a ground-swell for this amendment. I want to thank the various members for their praise. I want to echo what my friend Mr. Roemer said earlier today. I come to a different conclusion that Mr. Roemer about this piece of legislation, but I share his frustration with the budget agreement, and the constraints on which it poses upon us.

It pains me that we are not investing in robotics as we should as a Nation. The Japanese and the Germans are getting ahead of us. We are going to help the Canadians get ahead of us through space

station Freedom. Fiscal discipline is important and significant. I wouldn't be cutting back on NASA or on scientific research and development. It pains me when we have to, for the sake of fiscal discipline, sacrifice the future economic competitiveness of this country. Thank you, Mr. Chairman.

The CHAIRMAN. Does the gentleman desire a vote on his amendment, or does he wish to withdraw it?

Mr. BACCHUS. I withdraw the amendment.

The CHAIRMAN. Without objection, the gentleman withdraws his amendment.

Mr. ROEMER. I have a parliamentary inquiry.

The CHAIRMAN. The gentleman is recognized for a parliamentary inquiry.

Mr. ROEMER. I would like to thank Mr. Bacchus for his kind remarks and associate myself again with the frustrations of last year's budget agreement. My parliamentary inquiry, Mr. Chairman, is what happens on Mr. Walker's previous amendment on C when the money has been previously appropriated for something like the solar dynamic power research, and it is not spent. Does NASA then have the ability to——

The CHAIRMAN. NASA can request a reprogramming of those funds, and it is subject to approval by the committees of the House and Senate.

Mr. ROEMER. Thank you, Mr. Chairman.

The CHAIRMAN. Mr. Walker is recognized for the next amendment, Amendment I.

Mr. WALKER. I thank you, Mr. Chairman. Mr. Chairman, I am told by staff it is kind of interesting on the solar dynamic that the monies were appropriated only for solar dynamic at the time the appropriations bill was done last year, so that they do have a bit of a problem in re-programming in that particular instance.

The CHAIRMAN. They will figure out a way to get it.

Mr. WALKER. You are probably correct Mr. Chairman. Mr. Chairman, the next amendment I have, I would first ask unanimous consent for a correction in the figures in the amendment. The figure of $299,500 that is in the present should read $299,900. It was meant as an specific offset of $6 million and there is a misprint there.

The CHAIRMAN. Without objection that correction will be made.

Mr. WALKER. Thank you, Mr. Chairman. Mr. Chairman, this amendment restores the subcommittee's $6 million cut to the President's request for the exploration activities for fiscal year 1991. This is a relatively modest amount of money, but it sends a signal that the committee is backing off support of the President's space exploration initiative. I think this would be a real mistake for this committee to suggest that there should be no money for SEI, that instead the administration's space exploration initiative is something that should be abandoned by the authorizing committee.

I think that if we are looking to mission to planet Earth, we also ought to make sure that the research is going forward on mission from planet earth, both of which were highlighted in the Augustine report. This amount of money is aimed at doing that.

In order to come up with this money, I have gotten an offset. The restoration of the SEI money is offset by a reduction in the launch service account. It is my understanding that the Titan IV being

purchased by NASA from the Air Force will be available at a lower cost than originally anticipated. I am comfortable therefore that the cut that I am suggesting here in launch services can be absorbed, and thereby give us the money to proceed with a modest, but yet important program to advance the President's principal initiative of the space exploration initiative.

[The amendment offered by Mr. Walker follows:]

(short)

i)

AMENDMENT TO THE COMMITTEE PRINT

OFFERED BY MR. WALKER

On page 8, line 6, strike "$61,000,000" and insert in lieu thereof "$67,000,000".

On page 9 line 7, strike "$305,900,000" and insert in lieu thereof "$299,500,000".

The CHAIRMAN. I thank the gentleman. Do you have any comments Mr. Hall?

Mr. HALL. Yes, Mr. Chairman. I am opposed to the amendment. The Moon Mars program, we took $6 million out of NASA's requested $67 million and left $61 million in it for them. This amendment simply puts it back. I don't see where there is an offset there, although I'm sure the gentleman from Pennsylvania can show me. But even if he shows me, we are still faced with the fact that Augustine came here and testified, and if I recollect his testimony, he said if you cut anywhere, cut here. It is hard to cut other areas and not cut this one by 10 percent. It is a small cut. Actually if this amendment passes, it will be the only thing in NASA's budget fully funded and the subcommittee didn't feel that we ought to make Augustine's lowest priority the highest priority, and that would be the effect of Mr. Walker's amendment. As he says, it is not that much money, but it is an awful lot of principal and if you cut this thing only 10 percent as the subcommittee did, I think it makes sense and is in keeping with the testimony that came before the subcommittee. For that reason, I oppose the amendment.

The CHAIRMAN. Any further discussion on the Walker amendment? Mr. Walker?

Mr. WALKER. Just to make the point that I don't believe that it was Mr. Augustine's lowest priority. The fact is that the Augustine report says that we ought to be pursuing two initiatives as primacy in our programs. We ought to be doing the mission to planet earth, which I think is substantially supported by this budget, and we also ought to be doing the mission from plant earth, which is largely embodied in the Space Exploration Initiative.

The Mission To Planet Earth is funded through a number of ongoing programs. The only money which is really available to the mission from planet earth that moves us out toward the actual Moon and Mars is in this account. So, when you cut this fairly small account, you are cutting at the heart of what I see as the President's number one priority, and if it were simply trying to get in a confrontation with the administration, that is one thing, but I don't think this is some place where we want to confront the administration. Why not move forward on this program, and I am hopeful that this money can be funded at the level. The gentleman—I pointed out to the gentleman that there is money available in that launch service account because of the lower price of the Titan IV to assure that we can come up with sufficient monies to add that.

Mr. HALL. Would the gentleman yield?

Mr. WALKER. Sure.

Mr. HALL. I certainly do not want to leave this committee in a misquote on anyone, and I might ask staff if they can pinpoint the testimony, and if I am incorrect and anyone else on this committee doesn't remember Mr. Augustine's testimony as I do, I would like for you to speak up. I recollect him saying that this was their lowest priority, and if you cut anywhere, cut here. Maybe I am wrong. Mr. Chairman, would you ask the staff if they have any input on this.

The CHAIRMAN. The staff will be glad to respond to that inquiry.

Mr. SMITH. Yes, Mr. Hall, the relative priorities that were expressed by the Augustine committee was that science should be the number one priority; Mission To Planet Earth following that, and Mission From Planet Earth. In a practical sense, he also recommended the new launch system to be one of the first, most immediate things that we think about.

However, in a broader sense, and I will just—if you will allow me to read from the report, the Augustine committee was talking about the need to achieve a level of funding for NASA, .4 percent of the GNP by 2000, and I will just go to this quote. He says, "if the program cannot receive support from, program—meaning overall NASA funding, the administration and Congress at this level, then the achievement of goals of manned exploration program should be delayed, and the magnitude of the mission to planet earth reduced.

When we questioned Augustine and the panelists in written questions afterwards, and asked them to rank order some of the programs that we should look at, if there were short falls in the funding. Generally the mission from planet earth appeared at the bottom of that. I don't have the specific piece of paper before me, but that was the general rank ordering was that if you had to absorb reductions somewhere in the budget, Mission From Planet Earth appeared to be the place we should look.

The CHAIRMAN. Mr. Volkmer.

Mr. VOLKMER. I would like to ask the staff a question. The amendment reduces long services by $6 million. The amount in the bill is $305,900. What was the original amount that NASA requested for launch services?

Dr. SMITH. Mr. Volkmer, that was $341.9 million.

Mr. VOLKMER. So we have already cut launch services?

Dr. SMITH. In the process of the subcommittee markup, there was an original reduction that was predicated on the rationale that Mr. Walker talked about. There was another reduction that was made later as an offset to the commercial programs office. I think the situation is that there was a sizable amount of funding, some $90 million is my recollection, for the Titan IV which the actual need to obligate that funding is in fact part of the negotiations between NASA and the Department of Defense. The question is, rather there is excess hardware that would be provided later, allowing NASA not to have to obligate the funds in fiscal year 1992.

Mr. VOLKMER. What I see is I am going to support my subcommittee chairman very strongly in this because we've already cut launch services $36 million, we've only cut the provision for the future for planet earth by $6 million. They still have $61 million. I think that is sufficient to plan to go to the moon or mars. I think we can cut so much out of any one section, then we start hurting it. So, I think we should stick to our subcommittee chairman on this.

Mr. WALKER. Mr. Chairman, if I could raise a couple more questions here. First of all, we just did add back some money into this account a few minutes ago, so that we are in fact not talking about the same level of cuts that the gentleman just referred to. There has been money added back so that this account is different.

It is also my understanding that the cut that I am proposing here in law services was in fact recommended to us by the majority

staff as a place where we could find that cut if we wanted to go to SEI. Is that not correct?

Dr. SMITH. Mr. Walker, I think the precise number of dollars that will become available is simply not known yet. It may become known later this year. If the negotiations are completely successful, there will be enough money to provide——

Mr. WALKER. That's where the information came to my staff in terms of coming up with these cuts. So, I am not proposing something here which is going to undermine the low services account. In fact, even with my cut at the present time, we will still be higher in this account, given the actions of the committee thus far, than what the subcommittee had. Isn't that right?

Mr. SMITH. Yes.

The CHAIRMAN. The Chair would like to get to the amendment. If there is no one else desiring to speak, all those in support of the amendment offered by Mr. Walker will indicate by saying aye.

[Chorus of ayes.]

The CHAIRMAN. Opposed no.

[Chorus of noes.]

The CHAIRMAN. The Chair is in doubt and would like to call for a show of hands. Will those members in support of the Walker amendment kindly raise their hand.

[Show of hands.]

The CHAIRMAN. The ayes will put their hands down and the noes will raise their hands.

[Show of hands.]

The CHAIRMAN. The clerk will report.

The CLERK. Mr. Chairman, I have nine ayes and 11 noes.

The CHAIRMAN. The gentleman from Pennsylvania requests a roll call. The clerk will proceed to call the roll.

The CLERK. Chairman Brown?

The CHAIRMAN. No.

The CLERK. Mr. Walker?

Mr. WALKER. Aye.

The CLERK. Mr. Scheuer?

[No response.]

The CLERK. Mr. Sensenbrenner?

Mr. SENSENBRENNER. Aye.

The CLERK. Mrs. Lloyd?

[No response.]

The CLERK. Mr. Boehlert?

Mr. BOEHLERT. Aye.

The CLERK. Mr. Glickman?

[No response.]

The CLERK. Mr. Lewis?

Mr. LEWIS. Aye.

The CLERK. Mr. Volkmer?

Mr. VOLKMER. No.

The CLERK. Mr. Ritter?

Mr. RITTER. Aye.

The CLERK. Mr. Wolpe?

Mr. WOLPE. No.

The CLERK. Mr. Morrison?

Mr. MORRISON. Aye.

The CLERK. Mr. Hall?
Mr. HALL. No.
The CLERK. Mr. Packard?
Mr. PACKARD. No.
The CLERK. Mr. McCurdy?
[No response.]
The CLERK. Mr. Henry?
[No response.]
The CLERK. Mr. Mineta?
Mr. MINETA. No.
The CLERK. Mr. Fawell?
[No response.]
The CLERK. Mr. Valentine?
Mr. VALENTINE. No.
The CLERK. Mr. Slaughter?
Mr. SLAUGHTER. Aye.
The CLERK. Mr. Torricelli?
[No response.]
The CLERK. Mr. Smith?
[No response.]
The CLERK. Mr. Boucher?
[No response.]
The CLERK. Mrs. Morella?
Mrs. MORELLA. Aye.
The CLERK. Mr. Bruce?
[No response.]
The CLERK. Mr. Rohrabacher?
[No response.]
The CLERK. Mr. Stallings?
[No response.]
The CLERK. Mr. Schiff?
[No response.]
The CLERK. Mr. Traficant?
Mr. TRAFICANT. No.
The CLERK. Mr. Campbell?
[No response.]
The CLERK. Mr. Nowak?
[No response.]
The CLERK. Mr. Rhodes?
[No response.]
The CLERK. Mr. Perkins?
[No response.]
The CLERK. Mr. Barton?
[No response.]
The CLERK. Mr. McMillen?
[No response.]
The CLERK. Mr. Zimmer?
Mr. ZIMMER. Aye.
The CLERK. Mr. Nagle?
[No response.]
The CLERK. Mr. Gilchrest?
Mr. GILCHREST. Aye.
The CLERK. Mr. Hayes?
[No response.]

The CLERK. Mr. Costello?
[No response.]
The CLERK. Mr. Tanner?
[No response.]
The CLERK. Mr. Browder?
[No response.]
The CLERK. Mr. Geren?
Mr. GEREN. No.
The CLERK. Mr. Thornton?
[No response.]
The CLERK. Mr. Bacchus?
Mr. BACCHUS. No.
The CLERK. Mr. Roemer?
Mr. ROEMER. No.
The CLERK. Mr. Cramer?
Mr. CRAMER. No.
The CLERK. Mr. Swett?
[No response.]
The CLERK. Mr. Kopetski?
[No response.]
The CLERK. Ms. Horn?
Ms. HORN. No.
The CLERK. Mrs. Collins?
[No response.]
The CHAIRMAN. Was Mr. Slaughter recorded?
The CLERK. Mr. Slaughter is not recorded. I'm sorry.
Mr. SLAUGHTER. I vote aye.
The CLERK. Thank you.
Mr. WALKER. Mr. Chairman, how is Mr. Ritter recorded?
The CLERK. Mr. Ritter is not recorded.
Mr. RITTER. Mr. Ritter votes aye.
The CLERK. Mr. Chairman, I have 10 ayes and 13 noes.

The CHAIRMAN. 10 ayes and 13 noes, the amendment is not agreed to. The Chair would like to indicate that it is our expectation that the remaining amendments can be disposed of rather quickly and we can complete work on this by about 12:30. We would like to do that, and we will reschedule the markup on the other bill that was scheduled for today by proceeding until we complete this. We will be in a position to take this bill up on the floor next week if that is the desire of the leadership to do so. The Chair would like to ask the staff to call members and indicate that we could have a vote on reporting the bill within about a half-hour or sooner.

The Chair recognizes Mr. Bacchus for Amendment J.

Mr. BACCHUS. Mr. Chairman, I would like to ask unanimous consent to consider Amendment J simultaneously with Amendment B which is the related report language and also to accept substitute language which eliminates the blank check.

The CHAIRMAN. The gentleman requests unanimous consent to amend his amendment by substituting the figure $20 million for such sums and to consider in block with the report language. Is there objection. Hearing none, the gentleman may proceed.

Mr. BACCHUS. Mr. Chairman, to be brief, the changes here are two in number. First, rather than allowing an unstated sum for the

monies we hope to receive to refurbish infrastructure facilities at various federal installations throughout the country, we have established a cap of $20 million.

Second, we have added report language. The following sentence at the end of the report language says, "In addition, the committee believes funds for this program should not be secured from the transportation, research and development accounts." Our thinking there is that it makes no sense to improve our infrastructure if we are undermining our research efforts in transportation.

With these changes, I would seek the support of the committee for this amendment.

[The amendment offered by Mr. Bacchus and Mr. Lewis follows:]

(draft)

AMENDMENT TO COMMITTEE PRINT
OFFERED BY MR. BACCHUS AND MR. LEWIS

On page 19, line 2, insert the following after "$5,104,000":

and such additional sums as may be necessary to ensure the resiliency of the nation's space infrastructure

Mr. LEWIS. Mr. Chairman?

The CHAIRMAN. Mr. Lewis?

Mr. LEWIS. Thank you, Mr. Chairman. This amendment really rounds out the language we passed at last year's NASA bill where we are advertising we really and truly want a commercial space program. It may be strange that two gentlemen from Florida are offering this amendment. However, I must hasten to say that I am advised that the commercial launch programs into space are now being considered and looked at very seriously, and in some cases ready to go in the States of Hawaii, California, Texas, as well as Florida and Virginia. These states are really ready to make some moves. Hopefully, with the agreement of the gentleman from Wisconsin which we discussed capping this amendment, we can have unanimous consent of the committee. Thank you, Mr. Chairman.

Mr. SENSENBRENNER. Mr. Chairman?

The CHAIRMAN. The gentleman from Wisconsin.

Mr. SENSENBRENNER. Mr. Chairman, I move to strike to last word.

The CHAIRMAN. The gentleman is recognized for five minutes.

Mr. LEWIS. Let me state that I think that this is an acceptable compromise for purposes of this bill because it does eliminate the blank check. However, I do want to put it on the record my concern that since spaceports are private and hopefully profit-making activities some time in the future, that when this issue is revisited, as I am sure it will be as more of these spaceports get to a better stage of development, we ask ourselves the policy question of whether the financing should be by a grant out of any federal account, or whether it should be by some kind of a loan mechanism with a concessionary rate of interest or industrial revenue bonds and the like.

I am prepared to support the money that is proposed in here at this point in time, but I really think that if this is a profit-making activity, and there is some light at the end of the tunnel on that, we shouldn't be using grants for a considerable chunk of the construction expenses.

The CHAIRMAN. Mr. Volkmer?

Mr. VOLKMER. As I understand it, part of the of the unanimous consent request was to include in his motion the report language?

The CHAIRMAN. That is correct.

Mr. VOLKMER. I have a question that I would like to ask the staff. The last paragraph, second to last sentence says, "The committee believes the conditions of this requirement can be met through a grant program in which federal funds are matched by the States and the private sector." In our Commercial Space Launch Act, dealing with the amendments of last year, do we have such a grant program in place?

Mr. SMITH. No Mr. Volkmer, we did not institute a specific grant authority. We did not provide NASA the authority to issue grants at that time.

Mr. VOLKMER. Are the Department of Transportation? The Department of Transportation has no grant authority do they?

Mr. SMITH. Not specific to spaceports.

Mr. VOLKMER. So I question the inclusion of this language at this time. I don't know if the committee believes the condition of this can be met through a program.

Mr. BACCHUS. Will the gentleman yield?

Mr. VOLKMER. Yes.

Mr. BACCHUS. I would accept the deletion of that sentence from the report language.

The CHAIRMAN. Gentleman requests unanimous consent to delete that sentence.

Mr. BACCHUS. I would also like to suggest to the gentleman from Florida that if I'm not saying such a program may not be worthwhile. Maybe it is something we need to do, but I suggest that the gentleman look at the Commercial Space Launch Act and seek to amend that to provide the authority to do what he is attempting to do here.

Mr. LEWIS. Will the gentleman yield?

Mr. BACCHUS. Yes. I agree that is an issue for another day.

Mr. LEWIS. Thank you.

The CHAIRMAN. Mr. Walker?

Mr. WALKER. Mr. Chairman, I think Mr. Bacchus and Mr. Lewis are to be commended for their support of commercial spaceport, and I support the Bacchus Spaceport Financing Act and look forward to working for passage of that bill, but I'm not certain to what this isn't going the wrong direction for a couple of reasons.

First of all, setting up a grants program for commercial spaceports in the Department of Transportation is not the way to encourage development of the commercial space sector. Any kind of grant program that we put in place necessarily follows with massive regulation structure. That is the typical pattern at the federal level. So what you are going to do is you are going to immediately frustrate space entrepreneurs all over the place with a regulatory program in order to receive the grants. That is precisely the opposite direction we ought to be going in terms of getting appropriate investment.

The committee ought to be considering things like the idea of bonds and tax free bonds and a number of those kinds of things that stop the regulatory overload and go the right direction, rather than this kind of approach that I think will undermine rather than help.

I would also point out that insofar as you put this money through the transportation department funding, and you take it out of there, that is a fairly small office and a fairly small program there. If we are going to put this additional burden on them, it will take away from their ability to do other things which help the commercial industry.

One of the things that they badly need is the ability to do research there and do a lot of work that is necessary in order to make the commercial industry work. If we impose these kinds of programs we are undermining their ability to do the things that we provided in previous commercial bills, and I would suggest that this is not an appropriate way to proceed, and that is not the appropriate place to put this kind of additional burden at this time. So, I am very concerned about this particular amendment, even in its modified form, that it will have unintended consequences. I re-

alize that the wishes of the authors of the amendment are very good, but I am afraid that it undermines some of the very things we are attempting to achieve.

Mr. LEWIS. Would the gentleman yield?

Mr. WALKER. Sure.

Mr. LEWIS. The gentleman is aware that we do have an Office of Commercial Space Transportation and the DOT, and that is where we are directing this, but we are looking at this. There is no difference from a grant from DOT for this that under that OCST office other than for highway infrastructure or for airports. We are giving these grants all the time, so we are just making this another leverage and another availability to the States or to others to apply for a grant so that we can move ahead with our commercial space grant.

Mr. WALKER. As you pointed out and with the author of the amendment took out the language in the report because there is r.o such grant program. We are going to have to establish a grant program with all the regulations that go with a grant program in order to do this at the present time. What I am saying to you is that Office of Commercial Space Transportation at the Department of Transportation is a fairly small office at the present time. You are now going to put a burden on them over and above their ability to manage some of the things that we now have in place there. What I am suggesting is that this may not be the right approach in the right place in order to achieve the ends that the gentleman wants to achieve. I would be glad to yield to the gentleman from Florida.

Mr. BACCHUS. First of all, I want to thank the gentleman for his support of my proposed legislation, providing for federal tax exemptions or bonds issued by commercial spaceports in individual states. That is an important way to go and I am happy to hear that he supports that concept.

Second, I would like to point out that as amended, this particular report language does not contemplate a grant program, so I don't understand his apprehension.

Mr. WALKER. I guess the question is at that point then you are proposing up to $20 million for ensuring the resiliency of the Nation's space infrastructure program. What does that mean? What are we spending $20 million for at that point? Is it going to go to commercial spaceports? Is that the gentleman's intent?

Mr. BACCHUS. My intent, as I explained earlier, was to attempt in the transportation budget to obtain funds to refurbish the launch facilities on federal property.

Mr. WALKER. Somehow we are going to have to get that $20 million out and are we going to do that with a grant program?

Mr. BACCHUS. I am open to several suggestions. I am not as opposed to grant programs as you are, Mr. Walker.

Mr. VOLKMER. The way I envision it, and I don't know exactly what it does, it gives $20 million to the Department of Transportation, I assume, in the Commercial Space Launch Office. Now, what I envision is that the $20 million, since it is not in a grant program and no authority for that, that they could use the money, as the gentleman from Florida says, to upgrade our present launch facilities that the Government presently owns and we are getting

money, I think it is a pretty good idea getting money from transportation, $20 million to help our space program. I don't see anything wrong with that whatsoever.

Mr. WALKER. Can this money be used, for instance, to staff the Department of Transportation so that they are capable of handling such a program?

Mr. VOLKMER. I don't think it would be very much difficulty in that program for the gentleman to yield further, because I'm sure that NASA can give them all kinds of ways that we need to spend that money to upgrade our launch facilities and that they shouldn't need any additional staff.

Mr. WALKER. But let me point out that NASA is not engaged in this. If you are going to spend money on NASA facilities, then you'd better spend it through the NASA budget.

Mr. VOLKMER. I like the idea of getting it from the transportation budget.

Mr. WALKER. It is fine to talk about all of that, but the transportation department at the present time is not geared up to do this kind of program. That is the point. I see nothing in here which indicates that the $20 million can be used for instance, to staff the Department of Transportation in order to let them do it. I just think that you could end up with something that does more damage to commercial space than helps it, and I assure you I have been a long enough time advocate of commercial space that I've talked to people over the years, and the last thing that they need is regulatory overload at this point as a way of dealing with their problems.

Mr. PACKARD. Mr. Chairman?

The CHAIRMAN. The Chair recognizes Mr. Packard.

Mr. PACKARD. Mr. Mineta and I sit on the Surface Transportation Subcommittee and I would be interested in asking him, if I may, if in fact the rules would require that any grant of transportation funds to a Florida facility would be subtracted from Florida's allocation of transportation funds. I thought that there was something to that effect.

Mr. MINETA. Next question.

The CHAIRMAN. The Chair would like to bring this to a vote. Does the gentleman from Texas——

Mr. HALL. Yes, Mr. Chairman, I have a question. A very brief question and probably a helpful question. On the report language, I've read the three paragraphs you have there. I see no change in the first two paragraphs, correct? And the only change is you deleted the next to the last sentence beginning with, "The committee believes that the condition of this requirement can be met through a grant program in which federal funds are matched by the States and the private sector." Do you leave the last program in it, the last sentence, "In addition, the committee believes funds for this program should not be secured from the transportation research and development accounts."

Mr. BACCHUS. Yes, Mr. Chairman. I added that language at the request of Mr. Sensenbrenner.

Mr. HALL. But you deleted the previous sentence that talked about this grant program, and then you said it should not be se-

cured. If we've deleted it, do you need that last sentence, and does Mr. Sensenbrenner need that last sentence?

Mr. SENSENBRENNER. The gentleman from Texas will yield. I think we do need the last sentence to make sure that we are not trading research dollars for concrete dollars.

Mr. HALL. That protects the transportation research and development accounts.

The CHAIRMAN. Mr. Lewis.

Mr. LEWIS. Mr. Chairman, I am wondering if we have the same amendment in front of us for report language. The amended report language, I believe the last sentence did indicate that these funds would not come from research and development, and I believe the current one that we are discussing is not that particular amendment that you want to offer, Mr. Bacchus.

Mr. BACCHUS. Will the gentleman yield. I think that Chairman Hall's concern might be alleviated if we changed the word program to effort in the last sentence, therefore there would be a logical antecedent in the first sentence, and it would, I think, take into account Mr. Sensenbrenner's concerns.

Mr. LEWIS. If you just knocked out the words, "for this program."

Mr. BACCHUS. That is fine with me.

The CHAIRMAN. The gentleman is asking unanimous consent to eliminate the three words for this program.

Mr. BACCHUS. Yes, Mr. Chairman.

The CHAIRMAN. Is there any objection?

[No response.]

The CHAIRMAN. If not, the deletion is accepted. Any further comment with regard to either the report language or the amendment?

[No response.]

The CHAIRMAN. If not, the Chair will put the question. All those in favor will signify by saying aye.

[Chorus of ayes.]

The CHAIRMAN. Opposed, no.

[Chorus of noes.]

The CHAIRMAN. The ayes have it. The amendment is agreed to. The Chair would like to compliment the gentleman from Florida on his success and on his first go-around actually.

The next amendment is Mr. Traficant's. Mr. Traficant, are you going to help us move along rapidly?

Mr. TRAFICANT. Mr. Chairman, I ask for unanimous consent that the three amendments be considered in block.

The CHAIRMAN. Without objections, so ordered.

AMENDMENT TO THE COMMITTEE PRINT

Offered by Mr. Traficant of Ohio

Page 21, after line 2, insert the following new section:

SEC. 15. BUY AMERICA PROVISIONS

(a) RESTRICTIONS ON CONTRACT AWARDS.–No contract or subcontract made with funds authorized under this title may be awarded for the procurement of an article, material, or supply produced or manufactured in a foreign country whose government unfairly maintains in government procurement a significant and persistent pattern or practice of discrimination against United States products or services which results in identifiable harm to United States businesses, as identified by the President pursuant to subsection (g)(1)(A) of section 305 of the Trade Agreements Act of 1979 (19 U.S.C. 2515(g)(1)(A)). Any such determination shall be made in accordance with section 305.

(b) PROHIBITION AGAINST FRAUDULENT USE OF "MADE IN AMERICA" LABELS. – If it has been finally determined by a court or Federal agency that any person intentionally affixed a label bearing a "Made in America" inscription, or an inscription with the same meaning, to any product sold in or shipped to the United States that is not made in the United States, that person shall be ineligible to receive any contract or subcontract from the National Aeronautics and Space Administration, pursuant to the debarment, suspension, and ineligibility procedures in subpart 9.4 of

chapter 1 of title 48, Code of Federal Regulations.

(c) BUY-AMERICAN REQUIREMENT.– (1) The Administrator is authorized to award to a domestic firm a contract for the purchase of goods that, under the use of competitive procedures, would be awarded to a foreign firm, if–

(A) the final product of the domestic firm will be completely assembled in the United States;

(B) when completely assembled, more than 50 percent of the final product of the domestic firm will be domestically produced;

(C) the difference between the bids submitted by the foreign and domestic firms is not more than 6 percent.

(2) This subsection shall not apply to the extent to which–

(A) in the opinion of the Administrator, after taking into consideration international obligations and trade relations, such applicability would not be in the public interest;

(B) in the opinion of the Administrator, after consultation with the Secretary of Defense, compelling national security considerations require otherwise; or

(C) the President determines that such an award would be in violation of the

General Agreement on Tariffs and Trade or an international agreement to which the United States is a party.

(3) This subsection shall apply only to contract made for which–

(A) amounts are authorized by this title to be made available; and

(B) solicitations for bids are issued after the date of enactment of this Act.

(4) The Administrator, before January 1, 1993, shall report to the Congress on contracts covered under this subsection–

(A) entered into with foreign firms pursuant to a determination made under paragraph (2) of this subsection; and

(B) awarded to domestic firms pursuant to paragraph (1) of this subsection, in fiscal years 1991 and 1992.

(5) For the purposes of this subsection–

(A) the term "domestic firm" means a business entity that is incorporated in the United States and that conducts business operations in the United States; and

(B) the term "foreign firm" means a business entity not described in subparagraph (A).

Report Language to be Offered by Mr. Bacchus and Mr. Lewis

Add the following Committee view to Section 10 of the report:

IMPROVEMENTS OF SPACE TRANSPORTATION INFRASTRUCTURE

The Committee views with great concern the current condition of our nation's space transportation infrastructure, including launch sites and launch site support facilities. In many cases nationwide, equipment and facilities have not been adequately upgraded or maintained as required over the last decade. At many launch sites, the use of sandbags is necessary to support some blockhouse walls during launches. In addition, much of the electronic and other equipment in launch control centers is outdated.

The Committee supports improvements to the nation's space transportation infrastructure. Such improvements would make the existing launch sites safer, in addition to improving the nation's position in the international space launch marketplace.

The Commercial Space Launch Act, as amended in 1990, requires the Secretary of Transportation to facilitate and promote public-private partnerships involving the Federal government, state governments, and the private sector to build, expand and modernize the nation's space launch infrastructure. The Committee believes the conditions of this requirement can be met through a grant program in which federal funds are matched by the States and the private sector. In addition, the Committee believes funds for this program should not be secured from the Transportation Research and Development accounts.

Mr. TRAFICANT. Mr. Chairman, I ask for unanimous consent that the three amendments be approved without debate.

The CHAIRMAN. The Chair is not so sure about that one.

Mr. TRAFICANT. You wanted to speed it up. Mr. Chairman, these are amendments that have been added to other pieces of legislation. There has been much extensive debate on it throughout the committees and throughout the House floor. The House floor has held that these particular amendments were in fine constructive, in good order, and had in fact placed them and have been made into law in many particular areas of our procurement activities. They are specific, they are to the point, much of the decision rests with the administrators of our Government and the President himself in making these decisions. They can be waived by particular aspects of international law. They have been found to be solid and supportive. Most importantly, we attempt, through the budgets and through this amendment to bring some of the space budget down to earth. I give American companies a shot at it, and that is more than procurement activity. That also makes sure that we have a manufacturing and commercial infrastructure that can take care of the needs of America's space programs in the future and we will not have vacuums within that system, but must be interrupted by dependence on foreign providers.

The CHAIRMAN. The Chair would like to just make a couple of inquiries. First, the gentleman is offering the amendment which is distributed as a substitute for his three separate amendments which are included in the material. The Chair understands that the gentleman has discussed these with staff and that they do, in fact, reflect the intent or language of legislation previously adopted. Is that correct?

Mr. TRAFICANT. This is true Mr. Chairman.

The CHAIRMAN. Does the council verify that? Is there any further discussion.

Mr. HALL. I would like to ask one easy question. Did you take out your three to five penalty on them?

Mr. TRAFICANT. There are no penalties in here which would force this particular amendment to go to any other standing committee of the House. It leaves open the possibility that for fault, the administrator has the right, as any citizen, to take action, if he deems it necessary.

Mr. HALL. I understand.

The CHAIRMAN. Does that satisfy the gentleman's curiosity? If there are no further comments, the Chair will put the question. All those in favor of the substitute amendment offered by Mr. Traficant will indicate by saying aye.

[Chorus of ayes.]

The CHAIRMAN. Opposed, no.

[No response.]

The CHAIRMAN. The ayes have it and the amendment is agreed to.

The next amendment is one that I am offering, Amendment N. This is a very simple amendment and stems out of a fiasco with regard to the Hubble Telescope where NASA quality assurance personnel were precluded from entering into the plant where the telescope was being ground. This says that NASA shall not enter

into any additional contracts which prohibit quality assurance personnel from worksite unless this provision has been submitted to Congress sixty days in advance.

TB030

n)

AMENDMENT TO THE COMMITTEE PRINT
OFFERED BY MR. BROWN

Page 21, after line 2, insert the following new section:

SEC. 15. QUALITY ASSURANCE PERSONNEL.

(a) EXCLUSION OF NASA PERSONNAL.--A person providing articles to the National Aeronautics and Space Administration under a contract entered into after the date of enactment of this Act may not exclude National Aeronautics and Space Administration quality assurance personnel from work sites except as provided in a contract provision described in subsection (b).

(b) CONTRACT PROVISIONS.--The National Aeronautics and Space Administration shall not enter into any contract which permits the exclusion of National Aeronautics and Space Administration quality assurance personnel from work sites unless the Administrator has submitted a copy of the provision permitting such exclusion to the Congress at least 60 days before entering into such contract.

It is a relatively innocuous amendment. What we hope it will do is discourage the sort of thing that happened with regard to the Hubble. Any discussion?

[No response.]

The CHAIRMAN. If not, the Chair will put the question. All those in favor signify by saying aye.

[Chorus of ayes.]

The CHAIRMAN. Opposed, no.

[No response.]

The CHAIRMAN. The ayes have it and the amendment is agreed to.

Amendment O is offered by myself and Mr. Lewis and I would like to have Mr. Lewis—Mr. Lewis has left. Well, he doesn't get the credit or glory of this amendment then.

What this amendment does is establish a trust fund to be known as the National Aeronautics and Space Administration Endeavor, Teacher, Fellowship Trust Fund consisting of gifts and donations, accepted by NASA, which followed from the *Challenger* accident. These gifts and donations would become a trust fund for the support of a fellowship program and the fellows in that program would be selected U.S. citizens, undergraduates pursuing a course of study leading to teaching degrees in elementary and secondary education, and the award should be made according to standards established by the NASA administrator.

In other words, we are using these volunteer gifts to extend and contribute to the spirit represented by the astronauts that we lost in the *Challenger* accident who were on that flight, devoted to the enhancement of education to the space program.

Mr. Lewis has kindly agreed to co-sponsor this. I have kindly agreed to co-sponsor it with him. Is there any discussion of this amendment?

(short)

o)

BROWCA076

AMENDMENT TO THE COMMITTEE PRINT
OFFERED BY MR. BROWN AND MR. LEWIS

Page 21, after line 2, insert the following new section:

SEC. 15. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION ENDEAVOR TEACHER FELLOWSHIP TRUST FUND.

(a) ESTABLISHMENT.--There is established in the Treasury of the United States, in tribute to the dedicated crew of the Space Shuttle Challenger, a trust fund to be known as the ``National Aeronautics and Space Administration Endeavor Teacher Fellowship Trust Fund'' (hereafter in this section referred to as the ``Trust Fund''). The Trust Fund shall consist of gifts and donations accepted by the National Aeronautics and Space Administration pursuant to section 208 of the National Aeronautics and Space Act of 1958 (42 U.S.C. 2476b), as well as other amounts which may from time to time, at the discretion of the Administrator, be transferred from the National Aeronautics and Space Administration Gifts and Donations Trust Fund.

(b) INVESTMENT OF TRUST FUND.--The Administrator shall direct the Secretary of the Treasury to invest and reinvest funds in the Trust Fund in public debt securities with maturities suitable for the needs of the Trust Fund, and bearing interest at rates determined by the Secretary of the

Treasury, taking into consideration the current average market yield on outstanding marketable obligations of the United States of comparable maturities. Interest earned shall be credited to the Trust Fund.

(c) PURPOSE.--Income accruing from the Trust Fund principal shall be used to create the National Aeronautics and Space Administration Endeavor Teacher Fellowship Program. Such program shall award fellowships to selected United States nationals who are undergraduate students pursuing a course of study leading to certified teaching degrees in elementary education or in secondary education in mathematics, science, or technology disciplines. Awards shall be made pursuant to standards established for the fellowship program by the Administrator.

Mr. VOLKMER. I just have one question Mr. Chairman. I think it is a great amendment, but I would like it if council could tell me, or somebody could tell me, what we mean to selected United States nationals. What is a national? It doesn't say whether it is a noncitizen, an alien, or what is it?

The CHAIRMAN. Government judiciary working on many immigration bills, perhaps——

Mr. SENSENBRENNER. What that does is includes people who live in territories like Guam and American Samoa who are not full U.S. citizens but are eligible for U.S. passports and various other benefits extended.

Mr. VOLKMER. So, it includes not only the 50 states, but our territories.

Mr. SENSENBRENNER. That's correct.

Mr. VOLKMER. Very good. Thank you very much.

The CHAIRMAN. Any additional questions?

[No response.]

The CHAIRMAN. If not, the Chair will put the question. All those in favor signify by saying aye.

[Chorus of ayes.]

The CHAIRMAN. Opposed, no.

[No response.]

The CHAIRMAN. The ayes have it and the amendment is agreed to.

The last amendment that we have is Mr. Zimmer's amendment identified as P.

(short)

ZIMMER013

P)

AMENDMENT TO THE COMMITTEE PRINT
OFFERED BY MR. ZIMMER

Page 21, after line 2, insert the following new section:

SEC. 15. SPACE-BASED RESEARCH ASSESSMENT.

(a) NATIONAL ACADEMY OF SCIENCES CONTRACT.--The Administrator shall enter into a contract with the National Academy of Sciences for the conduct of the assessments described in this section.

(b) RESEARCH OPPORTUNITIES ASSESSMENT.--The contract entered into under subsection (a) shall provide for an assessment of methods for maximizing, based on a variety of prospective funding levels, the quantity and quality of opportunities for space-based life sciences and microgravity research on existing and proposed space vehicles and platforms. Such assessment shall focus on the 5-year period after the date of enactment of this Act, and on each of the two subsequent 5-year periods. Such assessment shall address opportunities in connection with domestic or foreign space vehicles and platforms, whether publicly or privately funded.

(c) SPACE STATION ALTERNATIVE ASSESSMENT.--The contract entered into under subsection (a) shall also provide for an assessment of methods of establishing a space-based research

infrastructure, based on a variety of prospective funding levels, using existing and proposed space vehicles and platforms, or other space vehicles and platforms constructed specifically for such purposes, as an alternative to the Space Station Freedom. Such assessment shall address the transferability of systems developed for use on the Space Station Freedom to such alternative space vehicles and platforms. Such assessment shall also address opportunities in connection with domestic or foreign space vehicles and platforms, whether publicly or privately funded.

(d) REPORT TO CONGRESS.--The Administrator shall, by June 30, 1992, submit to Congress a report containing the results of the assessments conducted under this section.

Mr. ZIMMER. Thank you, Mr. Chairman. I ask for unanimous consent that the amendment be amended by adding on the line 19, page 1, before the final word "research", the words life sciences and microgravity.

The CHAIRMAN. The gentleman asks unanimous consent to modify his amendment in the fashion indicated. Is there any objection to that?

Mr. VOLKMER. What is the line and page?

Mr. ZIMMER. It is line 19, page 1, after the word space based, and before the word research, insert life sciences, and microgravity, just to be specific and to be parallel to the construction elsewhere.

The CHAIRMAN. The gentleman is recognized for five minutes in explanation of his amendment.

Mr. ZIMMER. Thank you, Mr. Chairman. As the gentleman from Texas, Mr. Hall, pointed out, I did vote against the $2 billion authorization for the Space Station in the Space Subcommittee. The vote was 24 to 1 and I can take a hint, so I reformulated my approach. What I am proposing I hope will be construed as friendly amendment that can be supported by those who support Space Station, as well as those who are not convinced that it is worth the $30 billion current price tag.

What this would do is have the National Academy of Sciences take a look at all of our available resources in life, sciences, and microgravity, the two functions the Space Station is to perform, and see how we can maximize both the quantity and quality of the work that we are doing there. This can be very helpful even if Space Station is built because we can maximize and enhance our research during the period when the Space Station is under construction, and we can complement the work of the Space Station after it is fully constructed and fully manned.

This is not just another study of Space Station. It is an opportunity to see all the resources that we have and be most cost effective in the way that we spend——

The CHAIRMAN. Will the gentleman from New Jersey yield?

Mr. ZIMMER. Yes, sir.

Mr. SENSENBRENNER. I believe the gentleman from New Jersey has a very constructive amendment, and while I disagreed with his vote on the subcommittee level, I think that what he has done here will actually strengthen support for the station.

As we know, there has been some question of whether the station is scientifically justified as it has been reconfigured following the edict of the Appropriations Committee last year. By having the National Academy of Science go through the scientific aspects of the Station and what is proposed to be done in research once the Station is fully assembled, I think we will be able to have a much better case to present to the Congress and hopefully change some minds on the station, maybe including that of the gentleman from New Jersey.

Mr. BACCHUS. Will the gentleman from New Jersey yield?

Mr. ZIMMER. Yes.

Mr. BACCHUS. I would like to echo the statements just made by Mr. Sensenbrenner. I am a very strong supporter of Space Station Freedom. I heard Mr. Zimmer's remarks in subcommittee. I agreed

with much of what he said. I came to exactly the opposite conclusion.

As a representative of the taxpayers, I want to make certain that we build the right kind of Space Station. I want to make certain that it will do what we want it to do. I want to make certain that we can build on it.

I believe this amendment is a constructive one. We shouldn't make the mistake we did some years ago when we invested all of our marbles in the shuttle and didn't consider the need for alternatives. We have to look at alternatives. I am strong supporter of this amendment.

Mr. WALKER. I thank the gentleman for yielding. Am I correct in being assured that there is nothing in the general amendment that can be interpreted as being anti-Space Station; that this is an attempt to be complimentary to Space Station rather than undermining the Space Station.

Mr. ZIMMER. That's correct. It has the support of agnostics, such as myself and Space Station proponents as well.

Mr. WALKER. I thank you.

Mr. VOLKMER. I find a little bit different, and I find something that is very disconcerting in this amendment. If I read C, starting on page 17, I believe that the gentleman is attempting for us to find alternatives to the Space Station—alternative methods of doing life sciences and microgravity research, because it says so.

Our platform is as an alternative to the Space Station Freedom, not on the Space Station Freedom, not an assessment of what can be done on the Space Station Freedom, but as an alternative to the Space Station Freedom.

Mr. BACCHUS. Will the gentleman yield?

Mr. VOLKMER. I would be glad to yield.

Mr. BACCHUS. I have read that same section and come to the opposite conclusion. My reading is that we are mandating an assessment of alternatives, but that we are not any way bound to accept that assessment or be guided by it.

Mr. VOLKMER. I know you're not, but all you're doing is putting a perimeter—if you're not satisfied with the Space Station, maybe we ought to look at alternatives now, because it is going to be late. But if you ask the research council to make an investigation and come in as alternatives, and we are having trouble even funding the Space Station now, you are going to have more trouble next year. Then you are going to have them come in and say, will you all really be doing these as an alternative to the Space Station.

You may disagree with that, but that gets out all of the media, what do you think is going to happen to the Space Station?

Mr. BACCHUS. Will the gentleman yield?

Mr. VOLKMER. Yes.

Mr. BACCHUS. Well, they just did that a few weeks ago and we just voted $2 billion for the Space Station.

Mr. VOLKMER. But you haven't asked for this study, have you? You are asking for the study. This committee is asking for the study as an alternative to the Space Station. I don't see any point in it.

Mr. ZIMMER. Will the gentleman yield?

Mr. VOLKMER. Yes.

Mr. ZIMMER. The gentleman raises a legitimate point and I think there are a couple of answers to it. One is what Mr. Sensenbrenner said about the possibility that if the Space Station is as strong a scientific mission and he believes and you believe it is, that it will debunk the attacks of the critics, including myself.

The other is something we should be realistic about. This is an insurance policy in the event that Space Station gets defunded somewhere else. We have seen it nibbled almost to death by the Appropriations Committee, and if we are to the point where funding is reduced still further, I think we should have before us options rather than to be left completely without options. I believe that it simply gives us the facts and the truth shall make you free.

I'm not afraid of the truth and I don't think the strongest proponents of Space Station are afraid of the truth. I think we should know all the facts before us so we can make the most intelligent decisions.

Mr. VOLKMER. Would my colleague yield for a minute? I would just like to say I am not afraid of the truth, but a lot of it is based on what some people see as opinions. They are based on judgment, of course, and education, experience, etc. etc. But we have made that decision. Now, if we now say that we want to start looking at alternatives other than the Space Station at this time, I just don't see the sense in doing that. I could agree with B, but not with C. If you want to do an assessment on the Space Station as it is reconfigured as to whether or not it can do the life sciences and microgravity it is proposed to do, and those are the basic things, I won't disagree on that. I do disagree with this committee at this time saying we now want to look at an alternative to the Space Station. I yield.

Mr. WALKER. The gentleman I think does raise a good point. That is the reason I wanted to assure with the member that that was not his intent. That was the reason for the colloquy that I did. But I would also like to make the other point that the gentleman was here the same time I was when we lived through the whole space shuttle episode where we became convinced that because we had approved the space shuttle, we had to stick with it regardless of everything else that came up. As a result, we found ourselves in the mid-1980s without alternatives.

I can't imagine that having a study that assures us that there are some other alternatives out there in fact undermines Space Station at all. It seems to me that it enhances Space Station's position to be assured that while alternatives exist, this is still the best possible option. So, for that reason, I don't find that the gentleman amendment is troublesome.

Whether we ask for the study or not, alternatives are going to continue to be proposed. Some of them will be scientifically without merit and as a result, will be seen as being valid, even though they lack technological feasibility. If you have an appropriate place doing those kinds of studies and were informed about the alternatives, I can't imagine that will be a problem for us.

Mr. VOLKMER. All right, if they come back then and say that an unmanned Space Station purely serviced by robotics which has been proposed in the past, do you need that? You don't need that.

Mr. WALKER. Well, it certainly is an alternative and it ought to be looked at and weighed by policy-makers with regard to other things.

Mr. VOLKMER. It has already been decided.

Mr. WALKER. But the gentleman understands that a robotic nonmanned or tended Station does not give you any life sciences whatsoever. The gentleman specifically includes life sciences in his amendment.

The CHAIRMAN. The Chair again would like to urge expeditious consideration and will recognize the gentleman from California, Mr. Mineta.

Mr. MINETA. I thank the Chairman and I would like to either ask the gentleman from New Jersey expeditiously or to staff, what would be the cost of this assessment?

Mr. ZIMMER. I've been advised by staff that it would be $200,000 or $300,000.

Mr. MINETA. Where does that come from? Are we authorizing that to this bill, or are we taking it from somewhere else?

Dr. SMITH. NASA has an existing fund for carrying out studies with respect for the National Research Council.

Mr. MINETA. So it would be just a draw-down against that fund. It would not require any additional monies to be authorized.

Dr. SMITH. Right, that's correct.

The CHAIRMAN. The Chair would like to point out, and my remarks are triggered by Mr. Walker's statement that we might get these whether we ask for them or not, that the Space Studies Board Report was not asked for by NASA, it was independently generated by the National Academy and so may get additional reports of that sort.

The Chair would like to put the question, unless there is an urgent need for——

Mr. HALL. Mr. Chairman, I would like to be heard. I read the gentleman's amendment earlier that was presented the subcommittee, and then I looked at the amendment this morning. While Mr. Zimmer certainly wants to be constructive, and while his amendment would have been so very timely in 1978 or 1980, I think we are on a course now, and it does ask for a study of the space program because the platform, the only platform I may be educated that you are telling me that we have a platform up there now, I don't believe we do. I think the platform really is a Space Station. You use that word three times here. The only Space Station I know is MIR. The platform you are talking about would be the Space Station that this country would build. Is that not correct?

Mr. ZIMMER. There are the potential extended duration Space Lab and shuttle missions that could be used as well for these purposes. MIR would be one of the options that would be investigated, but by no means the only one.

Mr. HALL. You use the words, "systems developed for use on the Space Station Freedom to such alternative space vehicles and platforms." While I understand the gentleman to say this is not a study, it really has to be a study that you are asking for because you seek a report. I must admit that a lot of people up here issue reports without making any studies. We've seen some of those, but I think you are asking for a study here, are you not? And I think

would drive off and set off the work that has already been done on the Space Station, and would at least derail the thrust that this committee and this Congress has already made. While we've had disappointments, we are on track now and a study would simply delay it. It is a study because it requires a report in the very last sentence there.

Mr. ZIMMER. If the gentleman would yield. Yes it is a study, but what I said was it is not a study of the capabilities of Space Station, it is an evaluation of all the options that are available to us. That has not been done before. It will not slow down the project one moment. It will go on concurrently with the project. I'm not asking to take any money out of it.

Just as I voted for the bill in subcommittee, I will vote for the bill in committee. We are going to move forward as this is prepared and so it won't hold up the process.

Mr. HALL. You know it will hold it up until June 30, 1992.

Mr. ZIMMER. That's not the intention. The intention is to do this concurrently with the development. I do believe that is very clear from the text. We are not making anything contingent on the receipt of that report the way funding is contingent under your amendment.

The CHAIRMAN. The Chair would like to put the question. All those in favor of the amendment of the gentleman from New Jersey will signify by saying aye.

[Chorus of ayes.]

The CHAIRMAN. Opposed, no.

[Chorus of noes.]

The CHAIRMAN. In the opinion of the chair, the ayes have it.

Mr. HALL. Mr. Chairman, I would like a show of hands.

The CHAIRMAN. The gentleman from Texas requests a show of hands. Those in favor of the amendment of the gentleman from New Jersey will raise their hands and leave them raised until counted.

[Show of hands.]

The CHAIRMAN. Those in favor put their hands down. Those opposed will raise their hands.

[Show of hands.]

The CHAIRMAN. The clerk will report.

The CLERK. Mr. Chairman, I have 13 ayes and 10 noes.

Mr. HALL. Mr. Chairman, I ask for a record vote.

The CHAIRMAN. The gentleman from Texas asks for a record vote. The clerk will call the roll.

The CLERK. Chairman Brown?

The CHAIRMAN. No.

The CLERK. Mr. Walker?

Mr. WALKER. Aye.

The CLERK. Mr. Scheuer?

[No response.]

The CLERK. Mr. Sensenbrenner?

Mr. SENSENBRENNER. Aye.

The CLERK. Mrs. Lloyd?

[No response.]

The CLERK. Mr. Boehlert?

Mr. BOEHLERT. Aye.

The CLERK. Mr. Glickman?
[No response.]
The CLERK. Mr. Lewis?
Mr. LEWIS. Aye.
The CLERK. Mr. Volkmer?
Mr. VOLKMER. No.
The CLERK. Mr. Ritter?
Mr. RITTER. Aye.
The CLERK. Mr. Wolpe?
Mr. WOLPE. Aye.
The CLERK. Mr. Morrison?
Mr. MORRISON. Aye.
The CLERK. Mr. Hall?
Mr. HALL. No.
The CLERK. Mr. Packard?
Mr. PACKARD. Aye.
The CLERK. Mr. McCurdy?
[No response.]
The CLERK. Mr. Henry?
Mr. HENRY. Aye.
The CLERK. Mr. Mineta?
Mr. MINETA. No.
The CLERK. Mr. Fawell?
Mr. FAWELL. Aye.
The CLERK. Mr. Valentine?
Mr. VALENTINE. No.
The CLERK. Mr. Slaughter?
Mr. SLAUGHTER. Aye.
The CLERK. Mr. Torricelli?
[No response.]
The CLERK. Mr. Smith?
Mr. SMITH. Aye.
The CLERK. Mr. Boucher?
[No response.]
The CLERK. Mrs. Morella?
Mrs. MORELLA. Aye.
The CLERK. Mr. Bruce?
[No response.]
The CLERK. Mr. Rohrabacher?
[No response.]
The CLERK. Mr. Stallings?
Mr. STALLINGS. No.
The CLERK. Mr. Schiff?
Mr. SCHIFF. Aye.
The CLERK. Mr. Traficant?
Mr. TRAFICANT. No.
The CLERK. Mr. Campbell?
Mr. CAMPBELL. Aye.
The CLERK. Mr. Nowak?
[No response.]
The CLERK. Mr. Rhodes?
Mr. RHODES. Aye.
The CLERK. Mr. Perkins?
[No response.]

The CLERK. Mr. Barton?
Mr. BARTON. Aye.
The CLERK. Mr. McMillen?
[No response.]
The CLERK. Mr. Zimmer?
Mr. ZIMMER. Aye.
The CLERK. Mr. Nagle?
[No response.]
The CLERK. Mr. Gilchrest?
Mr. GILCHREST. Aye.
The CLERK. Mr. Hayes?
[No response.]
The CLERK. Mr. Costello?
[No response.]
The CLERK. Mr. Tanner?
[No response.]
The CLERK. Mr. Browder?
Mr. BROWDER. No.
The CLERK. Mr. Geren?
Mr. GEREN. No.
The CLERK. Mr. Thornton?
Mr. THORNTON. No.
The CLERK. Mr. Bacchus?
Mr. BACCHUS. Aye.
The CLERK. Mr. Roemer?
Mr. ROEMER. Aye.
The CLERK. Mr. Cramer?
Mr. CRAMER. No.
The CLERK. Mr. Swett?
Mr. SWETT. Aye.
The CLERK. Mr. Kopetski?
Mr. KOPETSKI. No.
The CLERK. Ms. Horn?
Ms. HORN. Aye.
The CLERK. Mrs. Collins?
[No response.]

Mr. HALL. Mr. Chairman, I would like the proxies. I would request the proxies be voted.

The CHAIRMAN. The Chair would like to indicate to the gentlemen that while he hasn't had a report yet, he feels that the vote will come out tied, and in that event the amendment will fail.

Mr. HALL. I will certainly take the Chairman's word for that, but my account shows that we may be one misguided vote short.

The CHAIRMAN. The Clerk will call the names of those who did not vote on the first roll call.

The CLERK. Mr. Scheuer?
[No response.]
The CLERK. Mrs. Lloyd?
[No response.]
The CLERK. Mr. Boehlert?
Aye by proxy.
The CLERK. Mr. Glickman?

Mr. HALL. Excuse me, Mr. Chairman, are you going to vote the proxies?

The CHAIRMAN. No, you vote the proxies.
Mr. WALKER. Mr. Chairman, parliamentary inquiry.
The CHAIRMAN. The gentleman will state it.
Mr. WALKER. Are the major proxies assigned to Mr. Hall?
The CHAIRMAN. Mr. Hall, I think, has a substantial number of proxies made out to him. Is that correct Mr. Hall?
Mr. HALL. We don't have Mr. Volkmer, he's here; Mr. Wolpe is here—we don't have his; Mr. Valentine, we do not have his; we don't have Mr. Thornton's and we don't have Mr. Roemer's.
The CHAIRMAN. Mr. Scheuer votes no by proxy. Ms. Lloyd votes no by proxy.
The CLERK. Mr. Glickman?
Mr. HALL. Mr. Glickman votes no by proxy.
The CLERK. Mr. Lewis?
Mr. HALL. Aye by proxy.
The CLERK. Mr. Ritter?
Mr. HALL. Mr. Ritter is now here.
Mr. RITTER. Aye, in person.
The CLERK. Mr. Morrison?
Mr. WALKER. Aye by proxy.
The CLERK. Mr. McCurdy?
Mr. HALL. Votes no by proxy.
The CLERK. Mr. Henry?
Mr. WALKER. Aye by proxy.
The CLERK. Mr. Fawell?
Mr. WALKER. Aye by proxy.
The CLERK. Mr. Slaughter?
Mr. WALKER. Aye by proxy.
The CLERK. Mr. Torricelli?
Mr. HALL. No by proxy. Did you get Mr. McCurdy no by proxy?
The CLERK. Mr. Boucher?
Mr. HALL. No by proxy.
The CLERK. Mr. Bruce?
Mr. HALL. No by proxy.
The CLERK. Mr. Rohrabacher?
[No response.]
The CLERK. Mr. Campbell?
Mr. WALKER. Aye by proxy.
The CLERK. Mr. Nowak?
Mr. HALL. No by proxy.
The CLERK. Mr. Rhodes?
Mr. WALKER. Aye by proxy.
The CLERK. Mr. Perkins?
Mr. HALL. No by proxy.
The CLERK. Mr. Barton?
Mr. WALKER. Aye by proxy.
The CLERK. Mr. McMillen?
Mr. HALL. No by proxy.
The CLERK. Mr. Nagle?
Mr. HALL. No by proxy.
The CLERK. Mr. Hayes?
Mr. HALL. No by proxy.
The CLERK. Mr. Costello?
Mr. HALL. No by proxy.

The CLERK. Mr. Tanner?
Mr. HALL. No by proxy.
The CLERK. Mrs. Collins?
Mr. HALL. No by proxy.
The CHAIRMAN. The Clerk will report the final vote.
The CLERK. Mr. Chairman, I have 23 ayes and 27 noes.
The CHAIRMAN. There being 23 ayes and 27 noes, the amendment is not agreed to. The Chair regrets very much the need to use proxies in a situation like this, and encourages the members to be present if possible.
That concludes the amendments before the committee. We have two or three cases of report language. Mr. Sensenbrenner?
Mr. SENSENBRENNER. Mr. Chairman, in order to save time, I ask unanimous consent that report language R by Mr. Henry, S by Chairman Brown, T by Mr. Stallings, and W by Mr. Walker be agreed to.

Amendment to Committee Report Language

Offered by Mr. Henry

(٢)

On page 20 of the Committee report, strike the paragraph entitled "Committee authorization recommendation", and insert in lieu thereof the following:

"Committee authorization recommendation

Section 4(a)(1)(C) authorizes $1,096,600,000 in fiscal year 1992, $1,321,400,000 in fiscal year 1993, and $1,308,500,000 in fiscal year 1994 for Physics and Astronomy. Of this amount, $6,000,000 has been transferred from the Materials Processing in Space budget line to allow alternate development of experiments that were to be Space Station attached payloads. Of the reductions from the President's request, $38,000,000 shall be taken from the Advanced X-Ray Astrophysics Facility account and a total of $12,000,000 shall be taken from the Orbiting Solar Laboratory and Space Infrared Telescope Facility mission studies accounts."

and on page 21,

Under Committee views, strike the Committee view entitled "Advanced X-Ray Astrophysics Facility (AXAF)"

5)

Amendment Offered by Mr. Brown
to the Committee Report

SECTION 4(a)(1)(F) EARTH SCIENCE AND APPLICATIONS

In the first paragraph, Committee Authorization Recommendation, make the following two changes:

(1) Change "the addition of $15,000,000 for Earth Probes" to "the addition of $10,000,000 for Earth Probes".

(2) Insert after the phrase "the addition of $1,000,000 for converting remote sensing data collected by classified remote sensing systems to civilian uses;" the following phrase:

"the addition of $5,000,000 for the procurement of long-lead parts for a follow-on to Landsat 6;"

Insert at the end of the Committee view on "Landsat Data Purchase" the following additional Committee view:

Procurement of Long-Lead Parts for a Follow-On to Landsat 6

The Committee notes with great concern the possibility that the delay in approval for a follow-on to Landsat 6 may lead to a significant gap in data continuity. Landsat 6 is scheduled to be launched in June 1992 and will nominally last until mid-1997. Once a decision is made to procure a Landsat 6 follow-on, as much as a year might be required to negotiate a contract. Construction of the satellite would then require at least four to five years. If long-lead parts are procured beginning in fiscal year 1992, the schedule for building a follow-on to Landsat 6 could be shortened by as much as six months to one year, reducing the likelihood of a data gap. The Committee notes that the recent delay in the launch of Landsat 6 has been caused by problems obtaining such parts.

The Committee recognizes that fundamental decisions about funding sources, institutional arrangements, and technical requirements must still be made before a follow-on satellite to Landsat 6 is approved. Nevertheless, the Committee believes that continuing the Landsat system is essential for global change research, national security applications, and other civilian and commercial uses. Because many of the long-lead parts required for the Landsat spacecraft and Enhanced Thematic Mapper are generic, and could be used on polar orbiting and other spacecraft currently being procured by NASA, the Department of Defense, and the National Oceanic and Atmospheric Administration (NOAA), the procurement of these parts would not commit the Government to funding a follow-on satellite. The Committee intends to work with the other committees in Congress and the Administration to develop a policy consensus on the future of the Landsat system, with the hope that this consensus will be accomplished in time to include funding in the fiscal year 1993 budget.

The Committee has provided $5,000,000 in NASA's budget to procure long-lead parts and intends to provide $5,000,000 in NOAA's budget and work to include additional funding in the Department of Defense budget. The Committee intends that NASA work with these other agencies to determine which long-lead parts should be procured, based on their impact on the Landsat construction schedule and their commonality to programs underway within each agency.

t)

Amendment Offered by Mr. Stallings
to the Committee Report

SECTION 4(a)(1)(N) SPACE RESEARCH AND TECHNOLOGY

Insert at the end of the Committee view on the Flight Telerobotic Servicer the following additional Committee view:

High Capacity Power

The Committee believes that the High Capacity Power program should play a significant role in meeting the needs of NASA's Civil Space Technology Initiative. Further, high capacity power systems for space applications have the potential for dramatic cost savings in spacecraft heat-to-electric conversion systems. Accordingly, the Committee encourages NASA to continue to emphasize the development of this technology.

(H)

AMENDMENT TO COMMITTEE PRINT
OFFERED BY MR. BACCHUS AND MR. LEWIS

On page 19, line 2, insert the following after "$5,104,000":

and such additional sums as may be necessary, not to exceed $20,000,000, to ensure the resiliency of the nation's space infrastructure

w)

REPORT LANGUAGE OFFERED BY MR. WALKER

Single Stage to Orbit

The Committee has long been interested in assured access to space, and is enthused about the recent declassification of developments in the single stage to orbit (SSTO) program with the Strategic Defense Initiative Office. The Committee supports the federal government's consistent support of basic research, but is concerned about the smaller level of effort which goes into the practical application of this research. The technologies developed in the SSTO program offer a great potential for civilian and commercial applications. NASA stands to benefit from the spin-offs in areas such as propulsion, materials, structures, and operations. The Committee directs NASA to study the potential technology applications of the SSTO program to civilian programs, and requests a report to Congress on these applications within 90 days of enactment of this legislation. Within the component technology program the Committee directs NASA to address the broadest possible range of technologies that have the potential for commercial spin-off into the civil marketplace.

- Mr. Walker -

Adopted Voice Vote. 5)

On pages 26 through 28 of the Committee report, strike the Committee view entitled "Earth Observing System" and insert in lieu thereof the following Committee view:

Earth Observing System

The Committee strongly supports the Mission to Planet Earth program because of its potential to dramatically improve our understanding of the Earth's environment and global change phenomena, including the impact of human activities on the environment. The Committee remains very concerned that the Earth Observing System program is not sufficiently resilient with respect to future budget shortfalls. Future budget constraints may lead to smaller funding levels than required to keep the original program on schedule, especially in a program with such large future funding requirements, and the only choice might be to further delay the large first platform. Already, a shortfall in the expected fiscal year 1992 budget request has forced deletion of one major instrument from the first EOS satellite, a delay in the launch of the first EOS satellite, and a delay in developing instruments for follow-on satellites. Cost overruns and technical difficulties in a program of this complexity may also cause delays and reductions in capability.

Some in the technical community have argued that the EOS program lacks resilience because all of the proposed instruments for EOS-A are placed on one large platform. This may lead to greater technical complexity and, in addition, instruments and spacecraft systems must be developed in parallel, leading to the potential for highly interactive schedule and cost risks. On the other hand, others argue that a single large platform, if it could be funded, would be the lowest cost approach to flying the suite of instruments presently envisioned.

The Advisory Committee on the Future of the U.S. Space Program found that "a combination of different size spacecraft appears to be most appropriate to meet the needs of simultaneity, accuracy, continuity, and robustness." The Committee notes that while the large platform concept addresses scientific requirements for simultaneity, these requirements are not absolute and other objectives, including continuity, program resilience and early return of data, are equally important.

As a result of the Augustine Committee's recommendation, the Administration is conducting an external engineering review of the EOS program. The results of this review will be essential for determining the future structure of the Mission to Planet Earth program. The Committee encourages this review panel to carefully examine the structure and content of the entire EOS program, including the first EOS-A satellite, and take concrete steps to make the program more resilient. The Committee recommends that the review panel consider the advantages and disadvantages of all available alternatives. If future budgets fall short of expectations, it is essential that the recommended alternative allow parts of the program to proceed on schedule while less urgent parts are deferred. The Committee also urges the review panel to consider the role of Landsat in the Mission to Planet Earth effort.

In the absence of the report of this external engineering review panel and an affordable plan for the EOS program, the Committee is not prepared to move forward with the proposed program. The Committee has reduced the Earth Observing System program without prejudice pending receipt of the report by $75,000,000 in fiscal year 1992, which represents approximately half of the requested increase.

The Committee has provided for ten percent real growth in the total budget for Earth Science and Applications in fiscal years 1993 and 1994, which reflects the Augustine Committee recommendation for ten percent real growth for NASA. The Committee would consider increasing the allocations for fiscal years 1992, 1993 and 1994 pending the submittal of the report of the external engineering review, as well as NASA's response, and the identification of an adequate budget "wedge" for the Earth Observing System.

The Committee notes the current lack of a U.S. launch vehicle capability with a payload capacity to polar orbits intermediate between that of the Atlas E and Titan IV launch vehicles. Establishing such a capability requires modifications and additions to the current facilities at Vandenberg Air Force Base and modifications to existing launch vehicles. The Committee recommends that NASA work with the Department of Defense (DOD) to ensure that any facilities planned by the DOD will also be available for use by NASA and any launch vehicle modifications take into account NASA's potential needs.

The CHAIRMAN. Mr. Henry's has been agreed to as a part of a prior amendment. With that exception. The Chair will ask if there is any objection to the request of the gentlemen?

[No response.]

The CHAIRMAN. If not, the Chair will accept the approval of those particular languages.

Is there any additional language or un-notified amendments that anyone would like to discuss. Mr. Walker?

Mr. WALKER. I have a report language with regard to the Earth Observation System and I don't think we need a lot of discussion on it. It has been cleared through staff. It was an attempt to modify some language to make certain that we did not prejudice a report in a study that we were asking for. We have cleared it and I don't think there is any problem with that.

The CHAIRMAN. The Chair has reviewed the language and it is acceptable to him. If there is no other objections, the language will be accepted.

Mr. VOLKMER. May I inquire the staff that the language that we had in subcommittee that I had some problems with, has that now been resolved in the report language?

Mr. SMITH. Yes, Mr. Volkmer. It has been agreed to.

The CHAIRMAN. All right, there being no further amendments and no further report language, a motion is in order to report the bill as amended. Mr. Walker?

Mr. WALKER. Mr. Chairman, I move this committee report the bill H.R. 1988 as amended, and to instruct the staff to prepare the legislative report to make technical and conforming amendments, and that the chairman take all necessary steps to bring the bill before the House for consideration.

The CHAIRMAN. The question is on the motion by the gentleman from Pennsylvania. All those in favor will signify by saying aye.

[Chorus of ayes.]

The CHAIRMAN. Opposed, no.

[Response of no.]

The CHAIRMAN. The Chair hears one no and will identify it as Mr. Roemer, in case you want to get out a press release on it.

Is there any additional action that needs to be taken at this point? The Chair would like to say that he very much appreciates the diligence of the members here this morning and regrets that we couldn't complete the additional bill. It is an important bill and we will schedule another markup meeting for that in the near future.

Let me say also that it is extremely important if we are going to have the impact that I would like to have this bill have, that we be prepared to support it vigorously on the floor if it comes up next week. I ask the members to do their best to do that.

There being no further business, the committee will stand adjourned.

[Whereupon, at 1:00 p.m., the committee adjourned, to reconvene at the call of the Chair.]

[Final amendment results follow:]

(Chart)

COMMITTEE MARKUP
April 24, 1991

MARKUP RESULTS

	Result
MEASURE: H.R. 1988, the National Aeronautics and Space Administration Multiyear Authorization Act of 1991	**REPORTED-Voice Vote**

Amendments

	Sponsor	Description	Result
a)	Mr. Torricelli	Strike finding on foreign launch services.	Rejected-division vote 12-20
b)	Messrs. Bacchus and Lewis	Finding relating to launch sites and launch site support facilities.	Adopted-voice vote
c)	Mr. Walker	Substitute for 4(a)(1)(A) regarding funds for the Space Station.	Rejected-voice vote
d)	Mr. Walker	Substitute for 4(a)(1)(B) regarding funding for space transportation capability and development.	Adopted-voice vote
e)	Mr. Henry	Restores FY 93 and FY 94 funds for AXAF.	Adopted-voice vote
f)	Mr. Brown	Long-lead parts for follow-on to Landsat 6.	Adopted-voice vote
g)	Mr. Bacchus	Redirect funds for commercial launch vehicle R&D from Space Research and Technology.	Adopted-voice vote
h)	Mr. Walker	Redirect funding for Space Exploration Initiative.	Rejected-roll call vote 10-13
i)	Messrs. Bacchus and Lewis	Space infrastructure amendment.	Adopted-voice vote
j)	Mr. Traficant	En bloc: New sections regarding "Restrictions on Contract Awards," fraudulent use of "Made in America" labels, and Buy-American requirements.	Adopted-voice vote

k)	Mr. Brown	New section regarding NASA quality assurance personnel.	Adopted-voice vote
l)	Messrs. Brown and Lewis	New section: NASA Endeavor Teacher Fellowship Trust Fund	Adopted-voice vote
m)	Mr. Zimmer	New section requiring National Academy of Science assessment of space-based research and Space Station alternatives.	Rejected-roll call vote 23-27
		Report Language	
n)	Mr. Henry	Substitute report language relating to AXAF.	Adopted-voice vote
o)	Mr. Brown	Amend report language relating to Earth Science and Applications and add new Committee View on Long-Lead Parts for Follow-on to Landsat 6.	Adopted-voice vote
p)	Mr. Stallings	Additional Committee View on High Capacity Power.	Adopted-voice vote
q)	Messrs. Bacchus and Lewis	Committee View on "Improvements of Space Transportation Infrastructure."	Adopted-voice vote
r)	Mr. Walker	New report language relating to the Single Stage to Orbit program.	Adopted-voice vote
s)	Mr. Walker	Substitute amendment to Earth Observing System report language	Adopted-voice vote

(14)

esa

european space agency
agence spatiale européenne

JUR/16.2.17.6/KM/DC/2355

Paris, 13 MAI 991

Mr George E. Brown, Jr
Chairman
Committee Science, Space
and Technology
2320 Rayburn House Office Bldg
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U.S.A

RECEIVED
JUN 6 1991
Committee on Science, Space and Technology

Dear Chairman Brown,

In the course of your Committee's mark-up of the NASA Multiyear Authorization Act of FY91, on 25 April 91, there was extensive debate over Amendment A offered by Rep. Torricelli. During this debate, a statement was made by Rep. Packard as follows:

> "What concerns me is that the European Space Agency has a very hard policy that will not permit them to send any of their government launch services on anything other than Arianespace. So they have locked up that corner of the marketplace and they now want to enter our marketplace and have the options to not only compete, but I think eventually control, or certainly to dominate the launching of our government payload". (As noted from draft hearing transcript on 5.3.91.)

I would like to take this opportunity to set the record straight as regards "ESA policy" and I would request that this letter be included in the hearing record to clarify the matter.

ESA has been, and continues to be, responsible for the development and qualification of the various generations of the Ariane launch vehicle. This responsibility has included carrying out four development flights of the Ariane 1 vehicle and one development flight of Ariane 4. Following certification by ESA that a particular generation of vehicle is flight qualified, a commercial company, Arianespace, takes over responsibility for procuring vehicles manufactured by the consortium that developed them. Arianespace then sells launch services world wide, and carries out the launches themselves.

Should ESA opt to launch one of its missions aboard an Ariane it will, therefore, procure the launch from Arianespace commercially. However, there is no "very hard policy" that constrains ESA from considering alternative launch options for its payloads.

ESA's launch procurement policy, as approved by the Member State governments, is described in Article VIII, Item 1, of the ESA Convention, a copy of which is attached to this letter. As you can see from this wording ESA:

- is not forced into automatically using the Ariane vehicle for its payloads
- is not precluded from considering other, non-European launch systems

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- has, in fact, considerable latitude in making launch system choices based on programme requirements rather than inflexible policy directives.

This inherent flexibility has been demonstrated on a number of occasions, i.e.

1. In the early 1980's ESA required a launch vehicle for its Exosat X-ray Astronomy Satellite. As no Ariane vehicle could be made available within the required time frame, ESA procured a Delta launch (out of Vandenburg) from NASA. It should be pointed out that Exosat was not an ESA/NASA co-operative project.

2. ESA has developed Eureca, the European Retrievable Carrier, for which it has procured launch and retrieval services via the Space Shuttle. The "very hard policy" referenced earlier in this letter would have required ESA to defer such a development until it possessed retrieval capabilities of its own.

3. Within its Science Programme, ESA is developing SOHO, the Solar Heliospheric Observatory Satellite. Under the terms of a co-operative agreement with NASA, NASA is providing the launch. The launch service was procured commercially by NASA, the contract being placed with General Dynamics, following a competitive procurement process from which Arianespace was excluded.

A number of examples could also be cited of ESA Member State governments who have opted for U.S. launch services, rather than Ariane, e.g. SAX (Italy), Skynet (UK) and EUTELSAT. To date the only case of a U.S. government related satellite flying on Ariane is the forthcoming launch of Topex under a Franco-American co-operation.

As regards the second part of Rep. Packard's statement, it has never been Europe's intention to "control, or ...[space!] dominate" the launching of U.S. government payloads. We are merely seeking consistency from the U.S. government in its approach to the matter of the opening of government markets to another country's commercial sector.

In this context, I would reference the language in Rep. Torricelli's revised amendment adopted on the House Floor which states "where foreign launchers are used, their use should be conditional on reciprocity form the foreign government in willingness to use United States launchers". Nothing in the aforementioned ESA Convention language precludes this.

Should you require further clarification of these issues, please do not hesitate to have your staff contact my office.

Yours sincerely,

G. van Reeth
Director of Administration

Enclosure

ARTICLE VIII

LAUNCHERS AND OTHER SPACE TRANSPORT SYSTEMS

1. When defining its missions, the Agency shall take into account the launchers or other space transport systems developed within the framework of its programmes, or by a Member State, or with a significant Agency contribution, and shall grant preference to their utilisation for appropriate payloads if this does not present an unreasonable disadvantage compared with other launchers or space transport means available at the envisaged time, in respect of cost, reliability and mission suitability.

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